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A CONTRIBUTION TO THE PHYLOGENY OF THE MYCETOPHILIDAE[1]

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The interest of the author was drawn to the study of thoracic sclerites as possible aids in the determination of the relationships of insects. In 1925, Dr. Crampton presented data to indicate the interrelationship of the non-tipuloid Nematocera based on a study of thoracic sclerites. From time to time, the author had made random observations on the shape of pleural sclerites in the Mycetophilidae, but until the present time, no attempt has been made to classify this family by the use of these sclerites.

It is recognized that the number of forms studied is far from complete. However, certain tendencies appear to be observable. It is hoped that the study will serve to stimulate interest in this group and that someone will develop this work to cover all of the genera.

In most cases the studies were made on males which were preserved in 80% alcohol. In a few instances only dried specimens were available. These were boiled in KOH, soaked in water, and then preserved in alcohol. The setae are omitted intentionally in order to present clearly the shape of the sclerites. Credit is given to Elmer Smith for the preparation of all the figures. Without his able assistance, the present work could not have been completed.

Before trying to develop a phylogenetic grouping for the genera of the Mycetophilidae, it will be best to discuss briefly some of the concepts concerning the evolution of the entire family. It is felt that this is essential in order to form an opinion of what a primitive or generalized Mycetophilid may be.

Enderlein, 1911, presented views concerning the interrelationships of the family. He derived the Mycetophilidae, the Bibionidae, the Scatopsidae, and the Cecidomyiidae from a common ancestry. Within the Mycetophilidae he appears to have regarded the Ceroplatinae as most primitive. The Macrocerinae were apparently derived from an ancestral stock similar to that of the Ceroplatinae. This view seems

[1]The author wishes to express his gratitude to Drs. C. P. Alexander and G. C. Crampton for their interest and helpful suggestions.

to be substantiated by some later workers who have indicated that the Macrocerinae should be included in the Ceroplatinae. The author does not agree with that grouping.

According to Enderlein the Bolitophilinae, the Pachyneurinae, the Mycetobinae and the Diadocidinae all were developed from one common stock. Of these, the Bolitophilinae were considered the most primitive.

The Sciophilinae and the Mycetophilinae were considered to have evolved from a distinct stock more closely related to the Simuliidae, the Cecidomyidae, the Scatopsidae and the Bibionidae and the Sciarinae than are the other Mycetophilid genera. It is probable that this is based on the opinion that the Sciarinae may have evolved through the Sciophilinae. I do not agree with this concept since I feel that the resemblance of certain Sciophiline genera to the Sciarinae is a case of parallel development.

Enderlein considered that the Sciarinae were more closely related to the Lestremiinae of the Cecidomyiidae than to the Mycetophilids. This is based on the presence of a dorsal eye bridge in both groups. Considerable controversy has existed concerning this grouping. Edwards has considered that the larvae of Mycetophila and Sciara show evidence of having been derived from a common stock on the basis of specialized labial structures and similar tracheal systems. On the basis of the present studies the Sciarinae show relationships with ***Hesperinus*** (Bibionide); ***Catocha*** and ***Rhabdophaga*** of the Cecidomyiidae. This is evidenced by the presence of a midpleural pit in all four genera, by the general shape of the katepisternum, and the presence of a precoxal bridge. The present study would support the belief that the Sciarinae, while of Mycetophilid stock, have characters sufficiently distinct to justify their being a separate family.

Crampton, 1925, considered that the Mycetophiliodea, i. e., Mycetobiidae, Mycetophilidae, and the Sciaridae, arose from the Anisopodidae themselves or from forms extremely like the Anisopodidae. Crampton felt that it would be extremely difficult to determine whether to group the annectant form, the Mycetobiidae, with the Anisopodidae or the Mycetophilidae. The same author considered that the Sciaridae are rather primitive Mycetophiloids and indicated that they should be given family rank. He did not feel that the Bolitophilinae, while primitive, are deserving of family rank, nor does he agree with Malloch that the Platyurinae should be raised to the same level.

Edwards, 1925, does not agree that ***Mycetobia*** represents an annectant form between the Mycetophilidae and the Anisopodidae. This view is based on the fact that the tracheal system of Mycetophila is more primitive than that of ***Mycetobia***. I feel that Crampton's views concerning the relationship of ***Mycetobia***, the Anisopodidae and the Mycetophilidae are more logical than those of Edwards.

Crampton, 1925, considered that the Cecidomyiidae are closely related to the Mycetophilidae and should be included in the superfamily Mycetophiloidea. This is based on the narrowing of the mesothoracic epimeron and the reduction of the meron, both of which characters occur in the Mycetophilidae. Crampton considered that the Bibionidae were derived from the same ancestral stock as the Mycetophiloidea and in a sense were intermediate between this group and the Chironomoidea.

Edwards stated that about the beginning of the Jurassic period, if not earlier, the Diptera were divided into three main groups. The first included the Mycetophilidae, Bibionidae, Scatopsidae, and Cecidomyiidae; the second, the Ptychopteridae, Culicidae, Psychodidae, and Chironomidae; the third, the Trichoceridae and the Tipulidae.

In 1942, Crampton advanced the belief that three main stocks arose from an Anisopodid-like ancestor. One branch gave rise to Mycetophilidae, Sciaridae and Cecidomyiidae, a second branch to Mycetobiidae, Anisopodidae and Trichoceridae, and a third to the Hesperinidae, Bibionidae, and the Scatopsidae.

The author feels that the Sciaridae possess characters indicating close relationship with the Mycetophilidae, the Bibionidae, and the Scatopsidae on the basis of the structure of the pleura.

With this as an introduction, I would like now to consider interrelationships among the Mycetophilidae. Meunier, 1904, advanced the belief that the Sciarinae were the most primitive with other members of the family being derived from this group.

Apparently Meunier considered the Bolitophilinae to be the most primitive of the Mycetophilidae excluding the Sciarinae. The Ceroplatinae, Macrocerinae, Mycetobiinae, and the Diadocidinae were represented as having been derived from the Bolitophilinae along similar lines. He derived the higher forms through the Sciophilinae which were a direct offshoot from the Bolitophilinae. The Bolitophilinae, while admittedly primitive, do possess some specializations which are not found in forms supposedly derived from the group. Some venational characters appear in *Bolitophila* which are not as primitive as those found in *Palaeoplatyura*.

Fisher, in correspondence, presented a scheme to show the interrelationship of the various groups. Her concepts are based on the study of the male genitalia as well as other characters. From her diagram, Fisher derived the subfamilies from a common ancestor with 5 main divisions. According to her beliefs, the subfamily Ditomyiinae is the most primitive of the Mycetophilidae. The Bolitophilinae are the second most primitive group, followed by the Diadocidinae. The Macrocerinae and Ceroplatinae were believed to have originated from a common stock a little higher in development than the Diadocidinae. She considered that the Mycomyiini arose next and gave rise to the Exechini and Mycetophilini. The Sciophilini, Gnoristini and Leiini were from the same stock. She considers that the Sciarinae arose from the Leiini.

With the exception of the development of the Sciarinae, my findings agree in the main with those of Fisher. I do consider that the Ditomyiinae are more highly evolved than certain of the Ceroplatinae.

With this as a review of what earlier writers have proposed I would like to begin a discussion of the findings of my study. Before doing this, I would like to indicate the features that seem to be primitive.

1. In all of the more primitive forms—*Sciara*, *Bolitophila*, *Palaeoplatyura*, *Symmerus*, *Apemon*—the mesothoracic episternum is unequally divided, resulting in the katepisternum being much larger than the anepisternum.

2. In the same forms, the anepisternum is divided by a cleft into an anterior and posterior portion.

3. In the more primitive forms, the pronotum is divided into two distinct portions. This is not the case in the higher forms.

4. In the more primitive forms, the mesothoracic epimeron, while narrower ventrally, does reach to the base of the mesothoracic coxa. In the more specialized forms the pleurotergite seems to develop anteriorly, thus narrowing the epimeron and in some cases cutting it off.

5. In the more primitive forms there is an indication of a suture separating the prescutum of the mesonotum from the scutum. This is lacking in the higher forms.

6. The presence of a meron is probably a primitive one. It is found in *Bolitophila*, *Apemon*, and there are indications of it in *Platyura* and some other forms. However, it is apparently reduced in *Palaeoplatyura* which, on the basis of venation, is more primitive than *Bolitophila*.

7. The more nearly perpendicular the mesopleural suture, the more primitive is the genus.

Having considered the characters which I consider to be primitive, I now wish to consider the various genera on the basis of these characters.

Sciara, figure 1, has a relatively large katepisternum, a wide epimeron, a distinct division of the pronotum into two portions. However, the mesosternal suture is destinctly angulate and the katepisternum is similar to that of *Herperinus*, *Catocha*, and *Rhabdophaga*. *Sciara* possesses a mid pleural pit as is shown in all of the three genera mentioned. The meron appears to be lacking. The sclerite indicated at the base of the mesothoracic coxa is probably the trochanter. It differs in these respects from other Mycetophilids and I feel that this evidence supports the concept that the Sciarinae represents a distinct family and I so propose to treat it.

Bolitophila, figure 2, possesses all of the thoracic characters I consider primitive with the exception that the indication of a suture distinguishing the prescutum and scutum of the mesonotum is not as distinct as it is in *Palaeoplatyura*. It is certainly near the base of the ancestral stock.

Symmerus, figure 3, while primitive as regards venation, is apparently somewhat specialized in other ways. The latepisternum is large and the anepisternum is divided as in *Bolitophila*. It is possible that what

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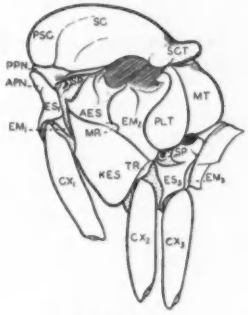
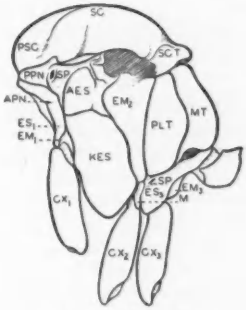
LIST OF ABBREVIATIONS

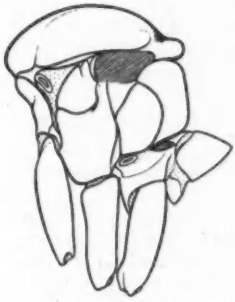
AES—Anepisternum of mesothorax.
APN—Anterior pronotum — pronotal scutum.
CX_1Prothoracic coxa.
CX_2Mesothoracic coxa.
CX_3Metathoracic coxa.
CXS—Coxal spur.
EM_1—Prothoracic epimeron.
EM_2—Mesothoracic epimeron.
EM_3—Metathoracic epimeron.
ES_1—Prothoracic episternum.
ES_2Metathoracic episternum.
KES—Katepisternum of mesothorax.
M—Meron.
MP—Midpleural pit.
MT—Mediotergite.
PLT—Pleurotergite.
PN—Post.
PPN—Posterior pronotum—pronotal scutellum.
PSC—Prescutum of mesonotum.
SC—Scutum of mesonotum.
SCT—Scutellum of mesonotum.
SP—Spiracle.
TR—Pleurotrochanter.



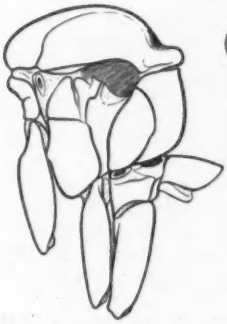
1. SCIARA



2. BOLITOPHILA

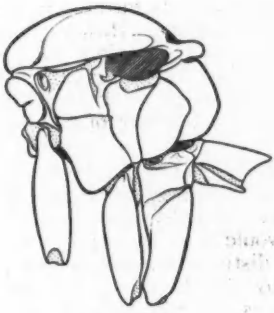


3. SYMMERUS

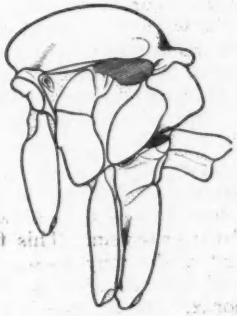


4. PALAEOPLATYURA

5. DIADOCIDIA



6. APEMON



7. PLATYURA

appears to be a dorsal lobe of the katepisternum may in reality be the posterior lobe of the anepisternum. However, the pleurotergite has developed an anterior process which apparently divides the mesothoracic epimeron into two distinct portions. I suspect that what seems to be a larger metapleuron may be actually a fusion of the meron and the pleura.

Palaeoplatyura, figure 4, from the standpoint of venation, is more primitive than *Bolitophila*. However, a true meron is not visible. The meso-epimeron is also narrower ventrally. The indication of a prescutellar suture is more distinct in *Palaeoplatyura* than in *Bolitophila*.

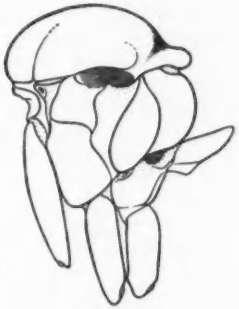
Diadocidia, figure 5, on the basis of thoracic sclerites, is more highly evolved than *Bolitophila*. The anepisternal cleft is not as deep, the mesoepimeron is narrowed ventrally and what I judge to be the remnant of the meron is apparently fused with the metapleura. The evidence of a prescutellar suture is very faint.

Apemon, figure 6, possesses several features indicating its primitiveness. The epimeron is relatively broad ventrally, the anepisternal cleft is deep, there is a small meron which is still attached to the eucoxa. However, as evidence of specialization, the thorax is depressed dorsoventrally. The venation, while primitive, is not as primitive as in *Palaeoplatyura*. The broader epimeron and the remnant of a meron would indicate that the genus is more primitive than *Palaeoplatyura*. In this case we have conflicting evidence as between the venational characters and thoracic sclerites.

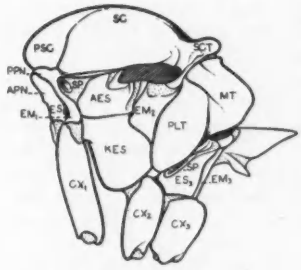
Platyura, figure 7, is clearly related to both *Palaeoplatyura* and *Apemon*. That it is more specialized than either is shown by the pronounced narrowing of the mes-epimeron. The anepisternal cleft is not as deep in this genus as it is in either *Palaeoplatyura* or *Apemon*. On the basis of venation, *Platyura* is more closely related to *Apemon* than to *Palaeoplatyura*. In *Platyura* there may be the culmination of a tendency of the meron to fuse back with the coxa. This tendency is indicated in *Palaeoplatyura*.

Macrocera, figure 8, in some ways appears intermediate in thoracic structure between *Palaeoplatyura* and *Platyura*. However, on the basis of thoracic sclerites, it does not seem to be close to *Apemon*. Indications of specialization are the sinuous mesopleural suture, the ventrally narrowed epimeron, the absence of the cleft in the anepisternum. The primitiveness is indicated by the lack of dorso-ventral depression.

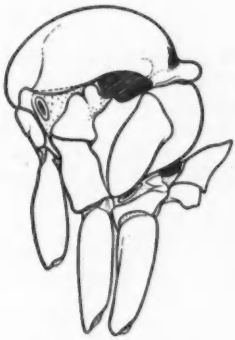
Fenderomyia, figure 9, on the basis of venation, is more primitive than Macrocera. The base of media is indicated as continuing from the wing base to the base of what has normally been considered to be the M-Cu crossvein. This form would seem to support the contention that media may possess three distinct branches in this group. Evidence of specialization is shown by the dorso-ventral depression of the thorax. Even more important is the reduction of the mesoepimeron. Whether the small triangular area above the base of the mesothoracic coxa is the remnant of the epimeron or a meron is open to question. I am inclined to the former view.



8. MACROCERA

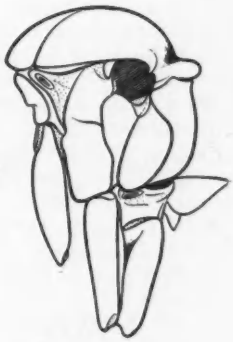


9. FENDEROMYIA

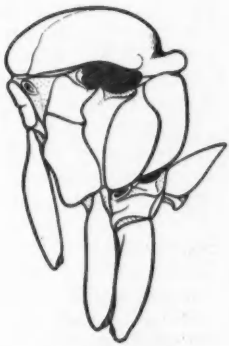


10. POLYLEPTA

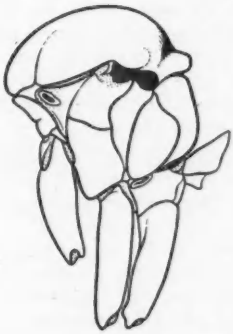
11. MYCOMYIA



12. LEIA



13. COELOSIA



14. BOLETINA

Polyepta, figure 10, shows characters similar to those of *Platyura*. It is more specialized than *Platyura*, as is shown by the narrowed epimeron and the smaller post pronotum. A small area in connection with the coxa would seem to be similar to the structure considered to be the meron.

Mycomyia, figure 11, on the basis of venation, would be considered fairly close to Polylepta. From the study of thoracic structures it is evident that a significant change has occurred. The katepisternum is reduced in size. This condition is universal in the more specialized forms. On the basis of male hypopygial characters, Fisher considered that *Mycomyia* would be an annectant form between the Sciophilini and the Mycetophilini. This is borne out by the study of the pleura.

As previously indicated, Fisher considered that the Sciophilini, the Gnoristini, and the Leiini, while derived from a similar stock, were not evolved from one another. This view is supported by the present study in that, while on the basis of venation *Polylepta* is more primitive than the following genus, on the basis of certain thoracic characters the following genus is more primitive.

Leia, figure 12, possesses a broader meso-epimeron than *Polylepta*. Also, the post pronotum is more distinct in this genus. Another primitive character is the more distinct indication of a suture between the prescutum and the scutum of the mesonotum.

Coelosia, figure 13, is very similar to Leia on the basis of thoracic structure. The narrowed epimeron indicates that this genus is more specialized than Leia.

Boletina, figure 14, is closely related to both *Coelosia* and *Leia* on the basis of pleural characters. I consider it the most specialized of these genera on the basis of the reduction of the epimeron and postpronotum.

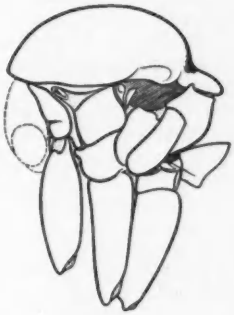
Of the Mycetophilini studied, *Phronia*, figure 15, seems to be the most primitive. The thorax is not markedly compressed dorso-ventrally, the epimeron is comparatively long, and is not as markedly oblique as in the other forms studied. In connection with this genus, the hexagonal shape of the anepisternum may be important as a distinguishing character. Another character which appears in Phronia and is developed more strongly in *Mycetophila*, *Opistholoba*, and *Sceptonia* is the groove in the lateral margin of the mesonotum caused by the pronotum pushing dorsally.

Allodia, figure 16, and *Exechia*, figure 17, are closely related I consider that *Allodia* is more primitive. I do not consider that *Allodia* and *Exechia* were derived through *Phronia*, but arose from a separate stock.

Mycetophila, figure 18, as already indicated, is related to *Phronia*. It is certainly closely related to *Opistholoba*, figure 19. In an earlier paper, I considered that *Opistholoba* should be united with *Mycetophila*. However, the greater dorso-ventral thoracic depression and the more oblique epimeron lead me to consider that *Opistholoba* is distinct from Mycetophila.

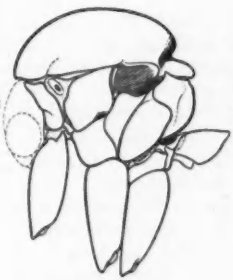
The position of *Epicypta*, figure 20, is somewhat problematical. As regards dorso-ventral depression it is intermediate between *Opistho-*

15. PHRONIA

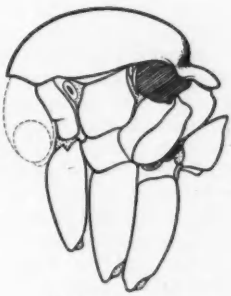


16. ALLODIA

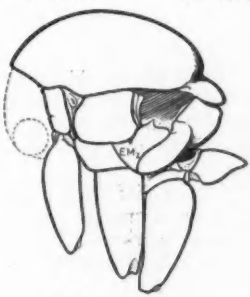
17. EXECHIA



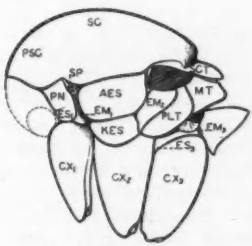
18. MYCETOPHILA



19. OPISTHOLOBA



20. EPICYPTA



21. SCEPTONIA

loba and *Sceptonia*, figure 21. However, there are two characteristics that distinguish it from these two genera. The ventral surface of the meso-epimeron is *Epicypta* is flaired at the tip. This is not true in either *Opistholoba* or *Sceptonia*. Neither is it true in the species of *Mycetophila* studied. A further distinguishing characteristic is that the prothoracic epimeron in *Mycetophila*, *Opistholoba*, and *Sceptonia* is relatively large and lobe-like. In *Epicypta* this structure is only moderately developed. The present indications are that while *Epicypta* is more highly developed than *Mycetophila*, its ancestry must have been from a stock lower than the *Mycetophila* complex. While I formerly united this genus with Mycetophila, my present study indicates that *Epicypta* is distinct.

The final genus to be considered is *Sceptonia*, figure 21. This is clearly the most highly specialized of all of the genera studied. In it the dorso-ventral depression of the thorax is most marked. A character apparently of generic value is the dorsal development of the prothorax so that the lateral margin of the mesonotum is interrupted.

From this study it is evident that the shapes of the thoracic sclerites afford characters that are of value in both taxonomic and phylogenic studies. They can be used to some extent as generic characters.

Based on the data presented in this paper it would seem possible to divide the family into two major groups based on the relative sizes of the anepisternum and the katepisternum. *Mycomyia* is considered to be the annectant form between the two major groups. In such a grouping, the Bolitophilinae, Ditomyiinae, Ceroplatinae, Diadocidinae, Macrocerinae and Sciophiliinae including the Gnoristini and the Leiini form one group and the Exechini and Mycetophilini another. It would seem that this would support Edwards' placing certain of the Mycetophilinae with the Sciophilinae.

Other characters of value in the taxonomy of this group include the cleft anepisternum as found in the more primitive groups, the narrowed epimeron and the dorso-ventral depression of the thorax. This last phenomenon causes a shifting of the epimeron, and the pleurotergum from a horizontal to a transverse position.

SUMMARY

The pleural sclerites of twenty-one genera of the Mycetophilidae are illustrated and comparisons made between the different forms.

On the basis of the study, it would appear that the group could be divided into two major divisions based on the relative sizes of the mesothoracic anepisternum and katepisternum.

The pleural sclerites of *Sciara* support the belief that members of this subfamily are sufficiently distinct as to be in a group by themselves. This is in agreement with various European workers. In the past, 1935, I have considered the Sciarinae to be a subfamily. I now recognize the group as a distinct family—the Sciaridae.

CONCLUSIONS

While it is admitted that insufficient genera have been studied, it is evident that the pleural sclerites are of value in classifying the Mycet-

ophilidae. It is hoped that this study will provoke sufficient interest to make a complete survey of the problem.

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A COMPARATIVE MORPHOLOGICAL STUDY OF THE PROTHORACIC GLANDULAR BANDS OF SOME LEPIDOPTEROUS LARVAE WITH SPECIAL REFERENCE TO THEIR INNERVATION[1]

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Very few papers deal with the prothoracic glandular bands of lepidopterous larvae. Toyama (1902) described them in *Bombyx mori* under the name "hypostigmatic gland," and more recently Ke (1930) described the variations in the same species under the name "prothoracic glands " In the present paper descriptions of the gland and its innervation are given for thirteen other genera representing eight different families of the order.

It is not yet proven that this is an endocrine gland, although the glandular appearance, absence of a duct and the type of innervation are suggestive of an endocrine function. It seems to the author [2] that the function of this gland would be worthy of study by insect physiologists.

The prothoracic glandular bands are symmertrically situated, one on each side of the prothoracic segment with the main part of the gland attached to the tracheae near the spiracle of the prothoracic segment. There may be four branches extending out from the main body of the gland: anterior, latero-ventral, latero-dorsal and posterior branches. The anterior branch, commonly quite elongated, extends towards the head and is commonly subdivided into an antero-dorsal and an antero-ventral branch, the two terminal ends commonly being attached to the integument on the ventral margin between the head and prothorax. The latero-ventral branch extends along innervating nerve fibers and is also commonly subdivided into two branches. The latero-dorsal branch is usually undivided and may be greatly reduced. A posterior branch was clearly recognizable in only one species (Bluina). The gland and its various branches are held in place by the associated tracheae and nerves shown in the figures.

The antero-ventral branch of the gland is usually associated with a ventral nerve of the suboesophageal ganglion. The latero-ventral branches are associated with the median nerve from the prothoracic ganglion. The posterior branch is commonly penetrated by a nerve from the interganglionic connective between the prothoracic and mesothoracic ganglia, and also by one of the ventral nerves from the

[1]This research was carried out in the Division of Entomology, Sun Yatsen University, China, in 1938. The author is indebted to Dr. A. G. Richards, of the Division of Entomology and Economic Zoology, University of Minnesota, for reading this manuscript.

[2]This paper was originally submitted for publication in China in 1938, but the Japanese invasion prevented its appearance. Since the above was written two experimental papers have been published demonstrating that these are indeed endocrine glands as Miss Lee and others had surmized.—Ed.

mesothoracic ganglion. As comparison of the various figures show, there is a tendency for a common pattern to the innervation but the details differ considerably from one example to another. Different species within one family are usually rather similar.

In most cases the glands are flattened, compact bodies arranged in a more or less band-like form. In a few cases the cells resemble a string of beads that are so loosely held together that they may be readily teased apart with needles. These two types are referred to in the descriptions as band-like and bead-like.

The species treated are arranged roughly in sequence beginning with the most primitive representatives and extending to the more highly evolved groups. Current concepts of evolutionary development within the order Lepidoptera suggests that the relationships of the families treated in the present paper are not sufficiently linear to warrant any evolutionary deductions from the small number of species studied.

Fig. 1. *Cnidocampa flavescens* Butler (Limacodidae). The prothoracic glandular bands are bead-like in appearance. The elongated anterior branch (1.3 mm. long) is undivided, winds around the longitudinal trachea to the head, and is dilated at its end; one side of the dilated terminal end is attached to a nerve from the prothoracic ganglion, the other side is attached by a fiber to the integument on the boundary between head and thorax. The latero-dorsal branch is a single row of cells (1.3 mm. long) which parallels a small tracheal branch; a very short branch arises from the basal portion of this and extends latero-dorso-posteriorly. The short latero-ventral branch is associated with a relatively complex nerve plexus.

In this family a special pair of nerves arises from the anterior median part of the prothoracic ganglion and extend laterally to innervate the anterior branch of the gland. The median and posterior parts of the gland are innervated from a plexus which receives fibers from the median nerve of the prothoracic ganglion, the connective between the prothoracic and mesothoracic ganglia and several ventral nerves from the mesothoracic ganglion.

Fig. 2. *Parasa* sp. (Limacodidae). Essentially similar to the preceding both in structure and innervation.

Fig. 3. *Clanis minuscula* Butler (Psychidae). A flat, broad band with a sickle-like bifurcation at the anterior end, and tapering latero-dorsal and latero-ventral branches. Total length about 1 mm. The anterior branch is innervated by a median and ventral nerve from the suboesophageal ganglion plus a ventral nerve from the prothoracic ganglion; one nerve from this group runs posteriorly along the anterior branch of the gland. The posterior part of the gland is innervated by fibers coming from both the median nerve of the prothoracic ganglion and ventral nerves from the mesothoracic ganglion.

Fig. 4. *Marumba* sp. (Sphingidae). Bead-like glands composed of chain of cells. The anterior, rather convoluted, branch divides and then the ends fuse near their point of innervation. The lateral and posterior branches form a network at the base of the anterior branch and cannot be differentiated into branches to be homologized with those recorded for the other species. The anterior branch is innervated only from the

ventral nerve of the suboesophageal ganglion. The more posterior network is innervated with fibers from the median nerve of the prothoracic ganglion and nerves from the interganglionic connective and mesothoracic ganglion.

Fig. 5. ***Schoenobius bipunctifer*** Walker (Pyralidae). A small, relatively simple band only about 0.6 mm. long. The dilated end of the anterior branch is associated with a ventral nerve from the suboesophageal ganglion and attached to the integument by a fine fiber. The slender latero-ventral branch is associated with a median nerve from the prothoracic ganglion and a ventral nerve from the mesothoracic ganglion.

Fig. 6. ***Chilo simplex*** Butler (Pyralidae). This species shows the simplest structure of all the species studied. The vase-like silhouette can be differentiated into antero-dorsal, antero-ventral, latero-dorsal and latero-ventral branches. The total length is about 0.6 mm. The anterior branch is innervated from a ventral nerve of the suboesophageal ganglion; the posterior part from a median nerve from prothoracic ganglion.

Fig. 7. ***Liparis dispar*** Linn. (Liparidae). A band-like gland. The elongated anterior branch (about 1.8 mm.) is undivided but expanded at its end. The latero-dorsal branch has an anteriorly directed prong. The latero-ventral branch forms a ring of cells along one of the nerves. The anterior branch is innervated by ventral nerves from both the suboesophageal and prothoracic ganglia. The latero-ventral branch receives nerves from the median nerve from the prothoracic ganglion, a nerve arising from the interganglionic connective and another from the mesothoracic ganglion. The latero-dorsal branch is innervated by fibers from the mesothoracic nerve.

Fig. 8. ***Sesamia inferens*** Walker (Phalaenidae). A band-like gland which in silhouette somewhat resembles a human leg. The undivided anterior branch is only 0.6 mm. long. The latero-ventral and latero-

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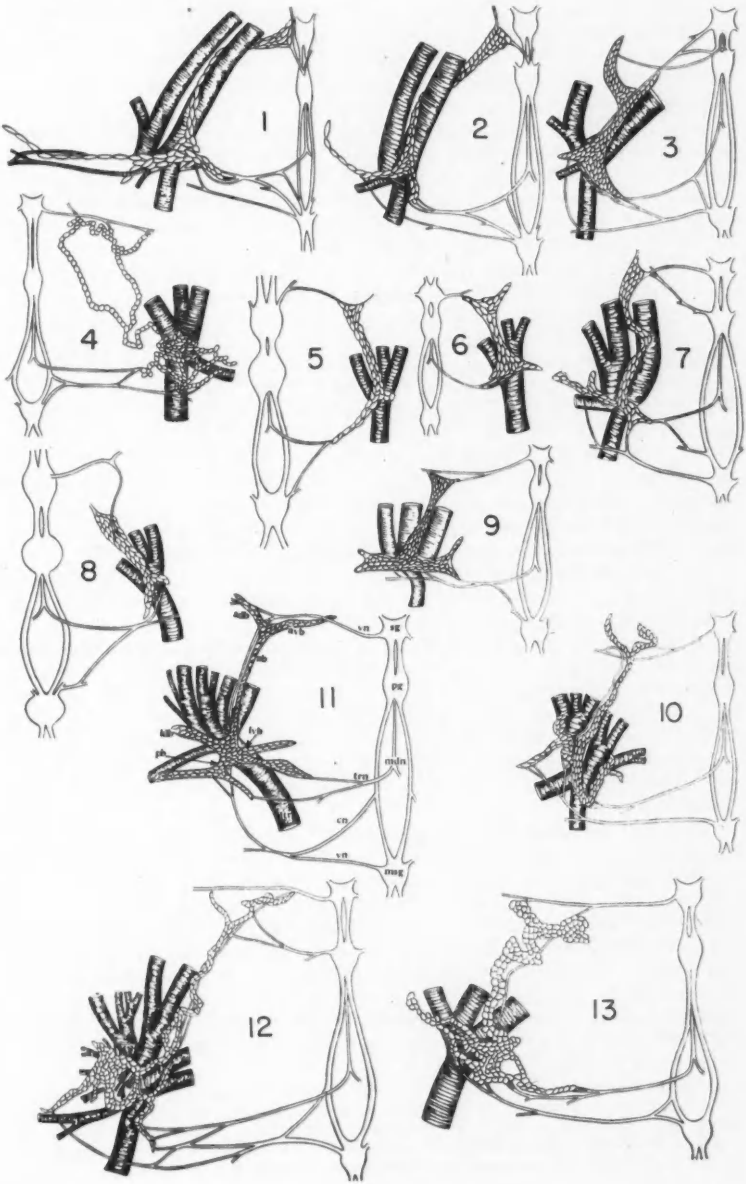
EXPLANATION OF PLATE I

Fig. 1. The prothoracic glandular band of *Cnidocampa flavescens*. Fig. 2. The prothoracic glandular band of *Parasa* sp. Fig. 3. The prothoracic glandular band of *Clania minuscula* Fig. 4. The prothoracic glandular band of *Marumba* sp. Fig. 5. The prothoracic glandular band of *Schoenobius bipunctifer*. Fig. 6. The prothoracic glandular band of *Chilo simplex*. Fig. 7. The prothoracic glandular band of *Liparis dispar*. Fig. 8. The prothoracic glandular band of *Sesamia inferens*. Fig. 9. The prothoracic glandular band of *Eligma narcissus*. Fig. 10. The prothoracic glandular band of *Dendrolimus spectabilis*. Fig. 11. The prothoracic glandular band of *Bluina idiota*. Fig. 12. The prothoracic glandular band of *Lebeda nobilis*. Fig. 13. The prothoracic glandular band of *Saturnia pyratarum*.

EXPLANATION OF ABBREVIATIONS

ab.....anterior branch.
adb.....antero-dorsal branch.
avb.....antero-ventral branch.
cn.....connective nerve.
ldb.....latero-dorsal branch.
ltr.....lateral longitudinal trachael trunk.
lvb.....latero-ventral branch.
mdn.....median nerve.
msg.....mesothoracic glanglion.
pb.....posterior branch.
pg.....prothoracic ganglion.
sg.....suboesophageal ganglion.
trn.....transverse nerve.
vn.....ventral nerve.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dorsal branches are both short. The anterior branch is innervated by a ventral nerve from the suboesophageal ganglion. The posterior parts of the gland are innervated by fibers from the median nerve of the prothoracic ganglion and from the ventral nerve of the mesothoracic ganglion.

Fig. 9. *Eligma narcissus* Cramer (Phalaenidae). A band-like gland in the shape of an inverted "T". The unbranched anterior branch is about 0.9 mm. long and expanded at its tip. The latero-dorsal and latero-ventral branches form a continuous transverse band about 0.8 mm. long with each branch bifurcated near the tip. The innervation is fundamentally the same as in *Sesamia*.

Fig. 10. *Dendrolimus spectabilis* Walker (Lasiocampidae). The band-like gland of this species is the simplest of the three species of this family examined. The anterior branch tapers somewhat to its bifurcation into antero-dorsal and antero-ventral branches. The latero-dorsal and latero-ventral branches are both bifurcated. The anterior branch is innervated from the suboesophageal ganglion. The posterior parts of the gland are innervated only from the median nerve of the prothoracic ganglion and the ventral nerve of the mesothoracic ganglion.

Fig. 11. *Bluina idiota* Graes. (Lasiocampidae). Species of this family show much more elaborate band-like glands. The elongated anterior branch (about 1.8 mm.) is bifurcated at the tip to form antero-ventral and antero-dorsal branches, both of which are attached at their ends to the integment between the head and prothorax. The latero-dorsal branch is single and measures about 0.5 mm. long. The latero-ventral branch bifurcates near its base to give rise to one free branch and one branch paralleling the transverse nerve. A posterior branch is present [3] and bifurcated to give dorsal and ventral lobes which together are about 0.8 mm. long. The anterior branch is innervated from the suboesophageal ganglion, the nerve dividing to innervate the anterior lobe and to send a nerve back to the main part of the gland. The posterior parts of the gland are innervated from the usual three sources, viz. the median nerve of the prothoracic ganglion, a nerve from the interganglionic connective and a ventral nerve from the mesothoracic ganglion.

Fig. 12. *Lebeda nobilis* Walker (Lasiocampidae). The details of the bandlike gland of this species are the most complicated of those of any species studied. The elongated anterior branch (about 2 mm. long) branches near its base, the two halves soon coming together again and fusing to form a ring; the anterior branch then follows a convoluted path anteriorly and finally divides into antero-dorsal and antero-ventral branches. The main part of the gland forms a large ring from which the branched latero-dorsal and latero-ventral branches arise. The posterior branch seems to be absent. The anterior branch is innervated from both the suboesophageal and prothoracic ganglia with nerves

[3]Since this posterior branch was found in no other species one could argue that its dorsal and ventral parts really are subdivisions of the latero-dorsal and latero-ventral branches with the separation extending all the way to the main body of the gland. For descriptive purposes the author refers to it as a separate posterior branch without meaning to imply an absence of homology.

extending posteriorly along it. The posterior part of the gland is innervated from a complex plexus the fibers of which originate from the same three sources as in the preceding species.

Fig. 13. *Saturnia pyratarum* Westwood (Saturniidae). A long convoluted bead-like gland. The anterior branch divides into relatively massive antero-dorsal and antero-ventral branches. The basal part of the gland forms a network with dorsal and ventral extensions that may be the same as the latero-dorsal and latero-ventral branches of the other species. The anterior branch is innervated from the suboesophageal ganglion. The posterior part of the gland is innervated from same three sources as in the last species.

SUMMARY

1. All lepidopterous larvae examined have prothoracic glandular bands in the vicinity of the prothoracic spiracles. These may be either band-like or bead-like strings of cells. From the main body of the gland there arises several branches; an anterior branch, a latero-dorsal branch, a latero-ventral branch, and sometimes a posterior branch.

2. Details of structure are diverse but species of the same family tend to be more similar than those of different families.

3. The most remarkable feature found was that the extensive innervation is highly diverse. In most cases the gland receives fibers from the suboesophageal, prothoracic and mesothoracic ganglia but the details are more or less different for all species studied.

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DESCRIPTIONS OF THE LARVAE OF SOME RUTELINE BEETLES WITH KEYS TO TRIBES AND SPECIES

(Scarabaeidae)[1]

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The subfamily Rutelinae reaches its greatest development in the neotropical region where the group is represented by 5 of the 6 known tribes (Blackwelder, 1944). In the United States and Canada only the two tribes Anomalini and Rutelini are represented but there is always the possibility that larvae of some species belonging to another tribe may be introduced as were larvae of the Japanese beetle, *Popillia japonica* Newman, and the oriental beetle, *Anomala orientalis* (Waterhouse), both belonging to the tribe Anomalini. The injurious Chinese rose beetle, *Adoretus sinicus* Burmeister, is now well established in the Hawaiian Islands and from there might be carried to our west coast.

A recent collecting trip to west Texas, Arizona, and California resulted in the discovery of the larvae of *Paracotalpa* (*Pocalta*) *ursina ursina* (Horn) and of *Plusiotis woodi* Horn, both of which are described in this paper. Larvae of *Adoretus sinicus* Burm., secured through the kindness of Walter Carter, and a reared larva of *Macraspis lucida* (01.), from Costa Rica, furnished by van Emdem, were also studied. The larvae of 14 species of the tribe Anomalini and of 3 species of the tribe Rutelini have been described previously by the writer and the literature on the contributions of other workers has been reviewed (Ritcher 1943 and 1945).

Subfamily **Rutelinae**

Larvae of the subfamily Rutelinae may be distinguished from other scarabaeid larvae by the following combination of characters: Mandible with a ventral, oval, stridulatory structure consisting of a number of transverse ridges. Maxilla with a row of anteriorly directed, sharp pointed, stridulatory teeth. Lacinia of maxilla with 1, 2 or 3 unci; if with 2 unci then the two are equal in size. Haptomerum of epipharynx with 2 or more prominent heli in a transverse row or with a raised mound- or beak-like process behind which are grouped 15 or more prominent spine-like setae not arranged in a definite transverse row. Epipharynx without proplegmata; plegmata present or absent. Dorsa of abdominal segments 9 and 10 never fused together. Raster with or without palidia. Anal slit transverse, slightly curved. Claws each bearing 2 setae.

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[1]The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director.

KEY TO TRIBES OF THE SUBFAMILY RUTELINAE
BASED ON CHARACTERS OF THE LARVAE

1. Last antennal segment with 2 or more dorsal, sensory spots (figs. 1 and 3). Haptomerum of epipharynx with a group of 15 or more prominent, spine-like setae (figs. 14, 15, and 18). Plegmata present or absent. Palidia, if present, polystichous, extending across lower anal lip (figs. 23 and 24), tribe **Rutelini**

Last antennal segment with a single, dorsal sensory spot (fig. 17). Haptomerum of epipharynx with a transverse row of 3 or more heli. Plegmata present. Palidia, if present, monostichous, not extending across lower anal lip (fig. 19) 2

2. Haptomerum of epipharynx with a transverse row of three (rarely 2 or 4) prominent heli. Palidia present, monostichous (fig. 19). Maxillary stridulatory area with 4 to 7 sharp recurved teeth. Lacinia of maxilla with 2 unci ..... tribe **Anomalini**

Haptomerum of epipharynx with a dense transverse row of 6 to 9 heli (fig. 16). Raster with a subtriangular teges of hamate setae; palidia absent (fig. 22). Maxillary stridulatory area with 8 or more sharp recurved teeth. Lacinia of maxilla with 3 unci (fig. 11) ..... tribe **Adoretini**

KEY TO SPECIES OF THE TRIBE RUTELINI
BASED ON CHARACTERS OF THE LARVAE

1. Venter of last abdominal segment with a teges (figs. 20 and 21) 2

Venter of last abdominal segment with 2 palidia each composed of a patch of medianly directed setae; palidia (and septula) extending longitudinally across the lower anal lip (figs. 23 and 24) 5

2. Head rather densely covered with setae (fig. 1). Haptomerum of epipharynx with a beak-like process (fig. 15). Haptolachus with a small, spine-like sclerotized plate (fig. 15). Maxillary stridulatory area with from 4 to 6 sharp teeth (fig. 10). Claws at least moderately long (figs. 7 and 8) 3

Head sparsely covered with setae (fig. 3). Haptomerum of epipharynx elevated but not beak-like (figs. 14 and 18). Haptolachus incomplete; sclerotized plate absent (figs. 14 and 18). Maxillary stridulatory area with from 8 to 14 sharp teeth (fig. 9). Claws short (figs. 12 and 13) 4

3. Labrum bearing 2 prominent, transverse, crescent-shaped ridges (fig. 1). Spiracles of abdominal segments 7 and 8 larger than spiracles of abdominal segments 1 to 6 ..... **Paracotalpa ursina ursina**

Labrum without prominent ridges. Spiracles of abdominal segments 7 and 8 smaller than those of abdominal segments 1 to 6 ..... **Cotalpa lanigera**

4. Labrum (and epipharynx) much wider than long, lateral margins not angulate. Epipharynx without epizygum (fig. 18) ..... **Pelidnota punctata**

Labrum only slightly wider than long, lateral margins angulate (fig. 3). Epipharynx with epizygum (fig. 14) ..... **Plusiotis woodi**

5. Left mandible with 2 scissorial teeth. Epipharynx with plegmata present but rather inconspicuous. Venter of last abdominal segment with a prominent septula between the polystichous palidia, anterior to the lower anal lip (fig. 23) ..... **Parastasia brevipes**

Left mandible with 3 scissorial teeth (fig. 2). Epipharynx without plegmata. Venter of last abdominal segment with septula vague between palidia, anterior to the lower anal lip (fig. 24) ..... **Macraspis lucida**

Paracotalpa ursina ursina (Horn), Third-stage Larva

Figs. 1, 5, 7, 8, 10, 15 and 20

Description based on the following material:

1. Four, third-stage larvae and 5 cast skins of third-stage larvae collected February 20, 1946, above Tessla, California, in Corral Hollow, by William Barr, Ray Smith, J. W. McSwain and the writer. The third-stage larvae were found from 6 to 12 inches deep in the soil

beneath *Artemesia* bushes and 3 of the larvae were feeding on the larger roots. The cast larval skins were found in pupal cells from 8 to 10 inches deep in the soil. Seventeen adult beetles were collected at varying depths ranging from close to the pupal cells to within 1 or 2 inches of the surface.

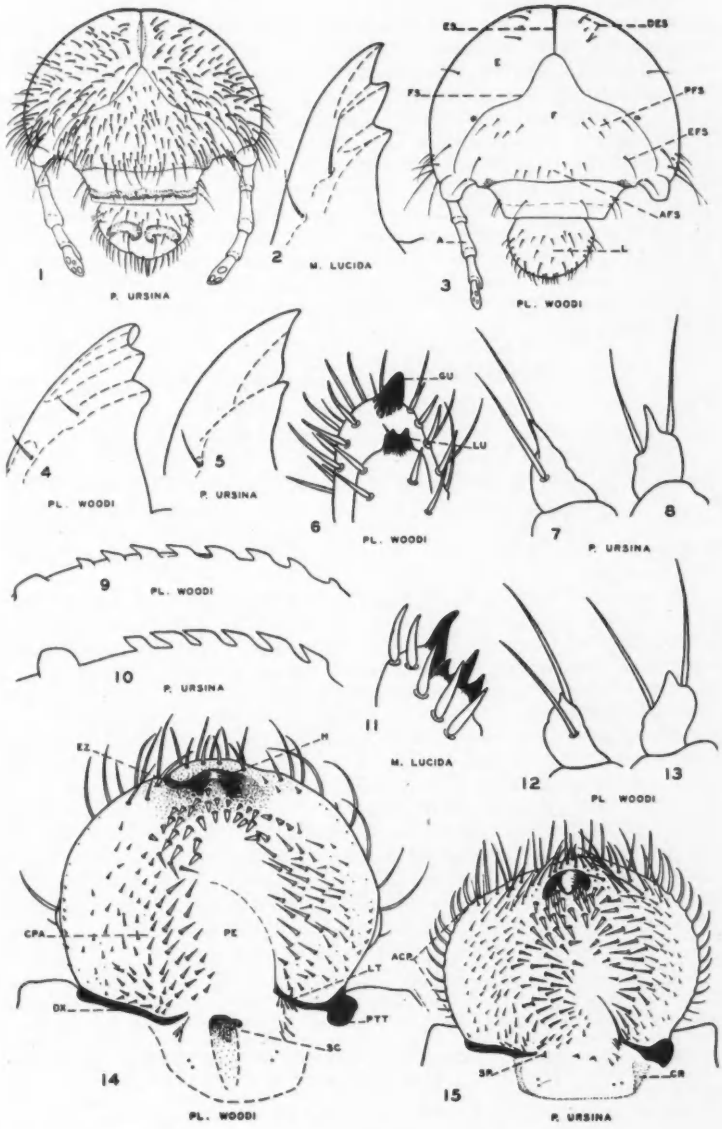
2. Three, third-stage larvae reared by the writer in August, 1946, from eggs laid by the above adults. No. 46-7E.

Maximum width of head capsule of third-stage larva 4.8 to 5.8 mm. Surface of cranium smooth, yellowish-brown, and rather uniformly covered with numerous setae (fig. 1). Clypeus with a prominent transverse ridge. Labrum wider than long and bearing 2 prominent, transverse, crescent-shaped ridges (fig. 1). Epipharynx (fig. 15) slightly wider than long. Haptomerum with a beak-like process behind which is a group of about 30 spine-like setae. Heli absent. Epizygum and zygum absent. Chaetoparia with almost no sensilla among the chaetae. Proplegmata and plegmata absent. Haptolachus complete with a small spine-like sclerotized plate adjacent to the dexiotorma and 2 median sense cones. Each mandible (fig. 5) with a blade-like portion anterior to the scissorial notch and a single, small, scissorial tooth posterior to the notch. Lacinia of maxilla with 2 unci which are alike in size and shape. Maxillary stridulatory area consisting of 5 or 6 sharp pointed, anteriorly directed, recurved teeth and a prominent distal, truncate process (fig. 10). Last antennal segment with 3 to 5 round to oval, dorsal, sensory spots (fig. 1).

Thoracic spiracles ranging from .41 to .52 mm. in length and from .267 to .28 mm. in width. Respiratory plate with a maximum of about 17 to 22 round to oval "holes" along any diameter. "Holes" not in definite rows. Distance between the two lobes of the respiratory plate equal to or only slightly less than the dorsoventral diameter of the bulla. Thoracic spiracles and spiracles of abdominal segments 2 to 6 inclusive very similar in size; spiracles of first abdominal segment noticeably smaller, those of abdominal segments 7 and 8 noticeably larger.

EXPLANATION OF PLATE I

Fig. 1. *Paracotalpa ursina ursina* (Horn). Head, dorsal view. Fig. 2. *Macraspis lucida* (01.). Scissorial area of left mandible, dorsal view. Fig. 3. *Plusiotis woodi* Horn. Head, dorsal view. A—antenna. AFS—anterior frontal setae. DES—dorsoepicranial setae. E—epicranium. EFS—exterior frontal setae. ES—epicranial stem. F—frons. FS—frontal suture. L—labrum. PFS—posterior frontal setae. Fig. 4. *Plusiotis woodi* Horn. Scissorial area of left mandible, dorsal view. Fig. 5. *Paracotalpa ursina ursina* (Horn). Scissorial area of left mandible, dorsal view. Fig. 6. *Plusiotis woodi* Horn. Distal part of left maxilla. GU—uncus of galea. LU—unci of lacinia. Fig. 7. *Paracotalpa ursina ursina* (Horn). Claw of left mesothoracic leg, side view. Fig. 8. *Paracotalpa ursina ursina* (Horn). Claw of left mesothoracic leg, dorsal view. Fig. 9. *Plusiotis woodi* Horn. Maxillary stridulatory area. Fig. 10. *Paracotalpa ursina ursina* (Horn). Maxillary stridulatory area. Fig. 11. *Adoretus sinicus* Burm. Distal part of left maxilla. Fig. 12. *Plusiotis woodi* Horn. Claw of left mesothoracic leg, side view. Fig. 13. *Plusiotis woodi* Horn. Claw of left mesothoracic leg, dorsal view. Fig. 14. *Plusiotis woodi* Horn. Epipharynx. CPA—Chaetoparia. DX—dexiotorma. EX—epizygum. H—haptomerum. LT—laeotorma. PE—pedium. PTT—pternotorma. SC—sense cone. Fig. 15. *Paracotalpa ursina ursina* (Horn). Epipharynx. ACP—acanthoparia. CR—crepis. SP—sclerotized plate.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Dorsum of seventh abdominal segment with 2 vague annulets, a prescutum and a scutum. Scutum with a dense covering of short, stout setae among which is a posterior transverse row of long setae. Prescutum with a sparse transverse band of long and short setae. Dorsa of abdominal segments 8 and 9 each with 2 well separated, sparsely-set, transverse bands of long and short setae. Dorsum of tenth abdominal segment with a rather conspicuous sclerotized, dorsal impressed line. Dorsal impressed line emarginate anteriorly. Venter of tenth abdominal segment without palidia (fig. 20). Teges consisting of a transverse patch of from 34 to 38 fairly short hamate setae with curved tips. Lower anal lip covered with similar hamate setae and with a caudal fringe of 17 to 38 long, cylindrical setae. Claws (figs. 7 and 8) sharp-pointed, each bearing 2 setae. Claws of metathoracic legs slightly shorter than those of mesothoracic legs; claws of mesothoracic legs shorter than those of prothoracic legs.

Plusiotis woodi Horn, Third-stage larva

Figs. 3, 4, 6, 9, 12, 14 and 21

Description based on the following material:

Two third-stage larvae reared from two second-stage larvae collected January 29, 1946, in the Davis Mountains, north of Ft. Davis, Texas, by the writer in an area suggested by H. A. Scullen of Oregon State College. The larvae were dug from rich soil and debris at the base of a walnut tree in a stream bed. Remains of 10 adults were found in the surface debris.

Maximum width of head capsule of third-stage larva 6.95 to 7.25 mm. Surface of cranium smooth, reddish-brown; labrium, clypeus and anterior half of frons reddish-black. Frons (fig. 3) bearing on each side, a patch of 4 or 5 posterior frontal setae, a single exterior frontal seta, 3 or 4 anterior frontal setae, and a single seta in each anterior frontal angle. Dorsepicranial setae 3 or 4 on each side. Labrum (fig. 3) slightly wider than long, nearly symmetrical. Epipharynx (fig. 14) with an epizygum and a raised haptomeral process behind which is a group of about 30 stout, spine-like setae. Chaetoparia with a few sensilla among the chaetae. Acanthoparia poorly developed. Plegmata and proplegmata absent. Haptolachus incomplete. Sclerotized plate absent. Left mandible (fig. 4) with 2 scissorial teeth anterior to the scissorial notch and a single scissorial tooth posterior to the same notch. Right mandible with only a single scissorial tooth anterior to the scissorial notch. Lacinia of

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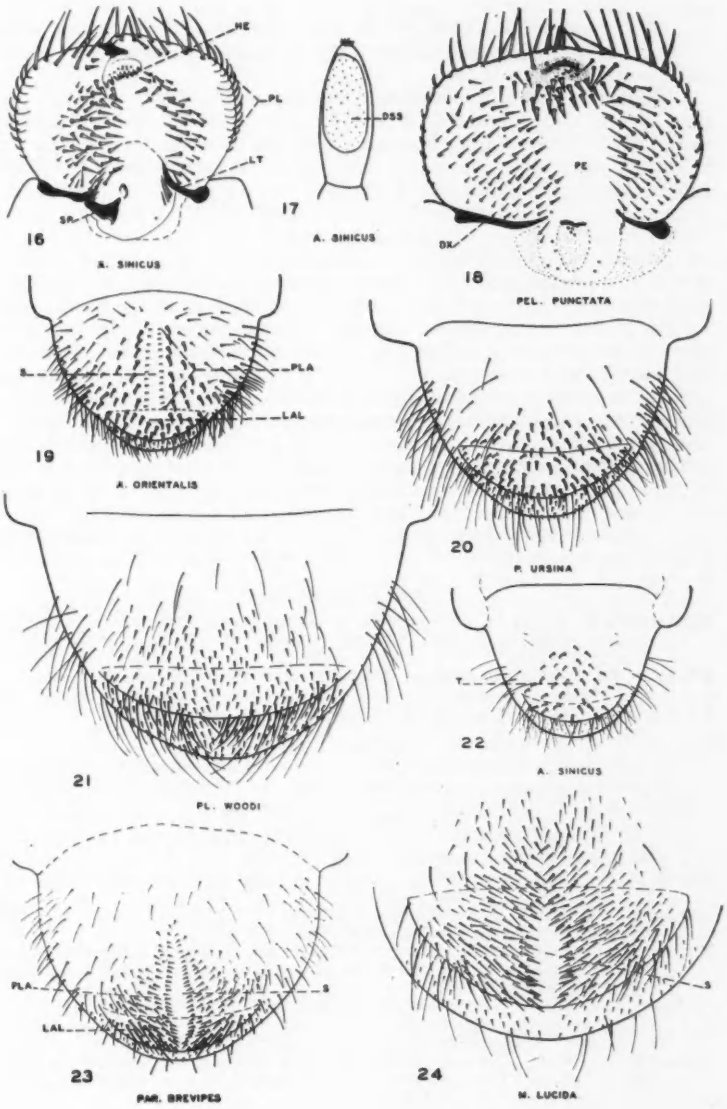
EXPLANATION OF PLATE II

Fig. 16. *Adoretus sinicus* Burm. Epipharynx. H—helus. PL—plegmatium. LT—laeotorma. SP—sclerotized plate. Fig. 17. *Adoretus sinicus* Burm. Last antennal segment, dorsal view. DSS—dorsal sensory spot. Fig. 18. *Pelidnota punctata* (Linn.). Epipharynx. DX—dexiotorma. PE—pedium. Fig. 19. *Anomala orientalis* (Waterhouse). Venter of last abdominal segment. LAL—lower anal lip. PLA—palidium. S—septula. Fig. 20. *Paracotalpa ursina ursina* (Horn). Venter of last abdominal segment. Fig. 21. *Plusiotis woodi* Horn. Venter of last abdominal segment. Fig. 22. *Adoretus sinicus* Burm. Venter of last abdominal segment. T—teges. Fig. 23. *Parastasia brevipes* (Lec.). Venter of last abdominal segment. LAL—lower anal lip. PLA—palidium. S—septula. Fig. 24. *Macraspis lucida* (01.). Part of venter of last abdominal segment. S—septula.


HE
PL
LT
SR
16
A. SINICUS
DSS
17
A. SINICUS
PE
DX
18
PEL. PUNCTATA
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PLA
LAL
19
A. ORIENTALIS
20
P. URSINA
T
22
A. SINICUS
21
PL. WOODI
PLA
S
LAL
23
PAR. BREVIPES
S
24
M. LUCIDA

maxilla (fig. 6) with 2 terminal unci which are fused together at their bases; dorsal uncus with a single seta. Maxillary stridulatory area (fig. 9) consisting of a row of 8 or 9 sharp-pointed teeth and a wide, anterior, truncate process. Last antennal segment (fig. 3) with 4 or 5 anal, dorsal, sensory spots.

Thoracic spiracles ranging from .8 to .86 mm. in length and .56 to .62 mm. in width. Respiratory plate with a maximum of about 32 oval to round "holes" along any diameter. Distance between the two lobes of the respiratory place much less than the dorsoventral diameter of the bulla. Spiracles of abdominal segments 1 to 6 similar in size and smaller than spiracles of abdominal segments 7 and 8. Thoracic spiracles distinctly larger than any abdominal spiracles.

Dorsum of seventh abdominal segment with two vaguely defined annulets, a prescutum and a scutum. Prescutum with a transverse lens-shaped patch of short, stout setae interspersed caudally with a few long setae. Scutum with a sparsely set transverse row of long and short setae anterior to which are a few short, stout setae. Dorsa of abdominal segments 8 and 9 each with 2 widely separated, sparsely set transverse rows of long setae among which are a very few short setae. Dorsum of tenth abdominal segment on each side with a sparse covering of long setae and short stout setae; median longitudinal area bare. Dorsal impressed line absent. Venter of tenth abdominal segment (fig. 21) without palidia. Teges consisting of a transverse patch of 47 to 55 fairly short, stout setae. Lower anal lip clothed anteriorly with similar setae, posteriorly with a fringe of 62 to 71 stout cylindrical setae. Claws (figs. 12 and 13) short, each with 2 setae.

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NOTES ON NEARCTIC HEMEROBIIDAE, WITH DESCRIPTIONS OF TWO NEW SPECIES

(Neuroptera)

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In a collection of Neuroptera from the University of Kansas, studied through the kindness of R. H. Beamer, two new Hemerobiidae were found. One is a very pale Californian species of *Sympherobius*. The other, a species of *Hemerobius*, was previously represented in the collection of the United States National Museum and is evidently widespread and common in the Far West, but was formerly confused with *Hemerobius pacificus* Bks. Because of the many records of *pacificus* as a predator on mites and insects of economic importance, certain of these records apparently are applicable to the new form, and biological control studies may be clarified by the knowledge that *pacificus* as formerly treated in literature is actually a composite species. The standard reference work on the taxonomy of the Nearctic Hemerobiidae is that of Carpenter (1940),[1] and I have endeavored to give notes and illustrations that will be supplemental to those in his comprehensive paper.

Although many Hemerobiidae may be identified by characters of the wings and other entirely external structures, other species may be recognized only by means of the male terminalia. The terminalia may be best examined after removing the apical portion of the abdomen and treating it mildly with either a cold or hot solution of caustic potash. It is important that this treatment be mild; otherwise, essential features will be rendered too pale and weakly sclerotized for effective study. The finished preparations are preserved in glycerol within a glass capsule attached to the pin on which the specimen is mounted. In the case of specimens preserved in alcohol, treatment with potash is not so necessary. When examining minute preparations in small watch glasses, I have found that movement of the preparation, and consequent difficulty of study, is prevented by lightly sticking the preparation to a little vaseline or one of the common household ointments placed in the bottom of the watch glass before adding alcohol. The figures of Carpenter (1940) show the relationship of the parts of the terminalia, and his terminology has been used here.

Genus **Hemerobius** L.

Of the 13 Nearctic species of *Hemerobius*, all occur west of the Rocky Mountains (several in the East also).

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[1]Carpenter, 1940, (Proc. Amer. Acad. Arts Sci. 74, no. 7: 194–253).

Hemerobius neadelphus,[2] new species

(Figures 1, 4, 6)

Male (*holotype*).—Of medium size for genus. Wings essentially as illustrated for allotype (fig. 1); right front wing with 6 inner gradates, upper one connecting R_4 with R_5. b, upper 4 gradates somewhat more closely spaced than in allotype; left wing with 5 inner gradates; attachments of ends of crossvein beyond fork of Cu_1 variable in right and left wings.

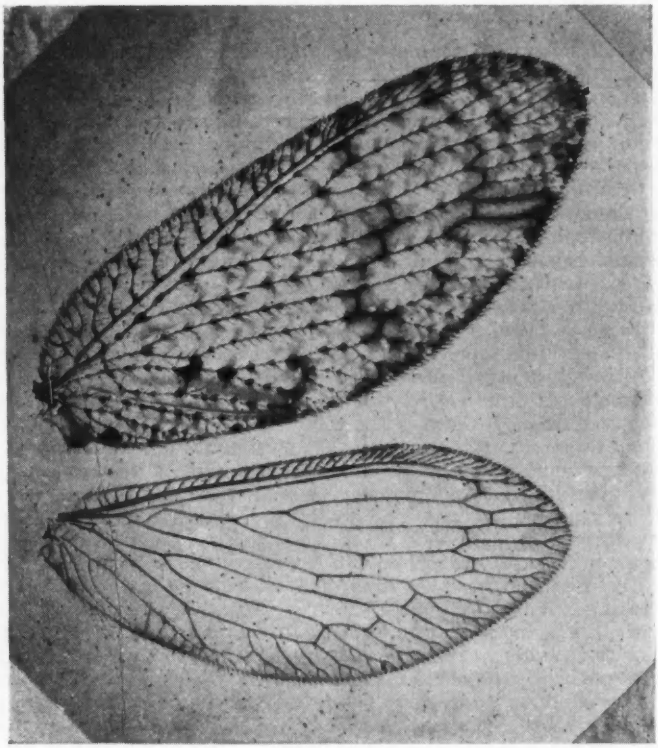

FIG. 1. *Hemerobius neadelphus*, new species, right wings of female allotype. Length of front wing, 9.2 mm. Photographed by M. L. F. Forbert, U. S. Department of Agriculture.

Terminalia (figs. 4–6): Tergum 9 unspecialized. Anal plate with 2 processes of subequal length, separating fork narrowly rounded; ventral process scarcely incurved in posteroventral view; dorsal process with

[2]From two Greek words meaning "new brother."

apex spinous, strongly recurved, much as in *pacificus*. Plates of aedeagus (fig. 5, aep) strongly curved, considerably enlarged in basal half, bridge of sternum 10 noticeably arcuate posteriorly.

Coloration: General body color pale brown; head and antennae pale, latter slightly darker on apical third; eyes black; thorax dark brown, a pale median longitudinal stripe of medium width; legs pale; wings marked with brown, less darkly than in allotype (fig. 1).

Measurements: Length of body, 5 mm.; of front wing, 7.6 mm.; width of front wing, 3.2 mm.

Female (*allotype*).—Agreeing with type in all important respects other than terminalia. Length of front wing ,9.2 mm., width, 3.4 mm.

The *paratypes* show that 5 is the normal of inner gradate veins. A few specimens have the dark wing markings lacking except for those on cubitus and the main stem of radius, and the body very pale except for brown lateral humeral stripes on the thorax. Wing length varies from 7 mm. (males from Utah and Yosemite National Park) to 9.2 mm. (females from Kaslo, B. C.). Wings of the Kaslo specimens are about 1 mm. longer than those from Yosemite National Park of the same sex.

Type locality. Kaslo, B. C.

Type. Male, United States National Museum, Type No. 58599, collected at type locality, on July 4, 1903, by R. P. Currie. *Allotype* taken there by Mr. Currie on July 2, 1903.[3]

Paratypes. 18 males, 8 females, from the following localities:

British Columbia. Kaslo: 4 ♀♀, July 8, July 24, Aug. 4, Aug. 5; 5 ♂♂, July 2 (2), July 8, July 15, Aug. 5 (all Currie, 1903).

Oregon. Siskyou, Jackson Co.: ♂, July, 6, 1946, elev. 3000 ft., (Borys Malkin).

California. Oakland: ♂, May 29, 1924 (H. G. Dyar). Berkeley: ♂, "Collected on *Baccharalis pilularis* 7–10–18" (I. J. Condit). Page Mill Rd., Santa Clara Co.: ♂, June 4, 1947 (J. W. Tilden). Alhambra: ♂, February, 1918 (W. M. Davidson). Yosemite National Park: 4 ♀♀, 5 ♂♂, Aug. 1, 1940 (R. H. Beamer). La Jolla: ♂, July 13, 1941 (R. H. Beamer).

Utah. Logan: ♂, Sept. 11, 1939 (Knowlton & Stains); ♂, Dec. 1, 1937 (L. L. Hansen).

Because of the lack of features known to distinguish females of *neadelphus* from those of *pacificus*, the only females included among the paratypes are those from Kaslo, B. C., and Yosemite National Park, Calif., associated with males. Paratypes will be deposited at the California Academy of Sciences, San Francisco, Calif., the Museum of Comparative Zoology, Cambridge, Mass., and at the University of Kansas, Lawrence, Kans.

H. neadelphus is distinguished from *pacificus*, with which it was formerly confused, by the following features of the male terminalia: The processes of the anal plate (figs. 2, 4) are separated by a narrowly rounded fork, rather than a broadly rounded, squarish interval; the ventral process of the anal plate is simple and scarcely incurved, rather

[3]This material was recorded by Currie, 1904 (Proc. Ent. Soc. Wash. 6: 85) as *pacificus*. Also see "An insect-collecting trip to British Columbia" (ibid. 6: 24–37, 1904), by the same author.

than strongly incurved (figs. 6, 7); the plates of the aedeagus are more swollen basally than those of *pacificus* and they are less widely separated where attached to the arcuate, instead of the practically straight, bridge of sternum 10 (figs. 3, 5). In both species the tips of the aedeagal plates may be widely or narrowly separated, depending on the condition and manipulation of the specimen. Judging from the males examined (*neadelphus*, 19; *pacificus*, 7), there is no appreciable variation in the above characters.

Aside from *pacificus*, the species most likely to be confused with *neadelphus*, because of prevalence or comparable features, are *conjunctus* Fitch (especially in British Columbia), *ovalis* Carp. and *stigmaterus* Fitch (see figs. 8–10). Other species are not likely to be confused with *neadelphus*, and several are relatively rare. It may be noted that the illustrations have been made to show the plates of the aedeagus in a single plane, though the plates of certain species extend ventrally much more than those of others. The plates of the various species may be compared more directly if all are studied in the same plane.

Carpenter (1940) treated *pallescens* Currie, 1904, and *discretus* Navas, 1917, as synonyms of *pacificus*. The Navas type, collected at Jemez, N. M., is not now available for study. In the light of present distribution records, however, the above synonymy of *discretus* appears correct. The possibility that *pallescens* may be the same as *neadelphus* poses a more critical problem, at present unsolvable. The type of *pallescens* is a large yellowish female, the front wing of which measures 10 mm., collected May 30, 1903, at Fieldbrook, Humboldt Co., Calif. Since both *pacificus* and *neadelphus* probably occur in that vicinity, the identity of *pallescens* can not further be clarified until characters separating females of those species are known, or until detailed information concerning the *Hemerobius* population at the type locality is available.

Records suggest that *neadelphus* may be more common than *pacificus* in California and other Pacific Coast States, though the latter is repre-

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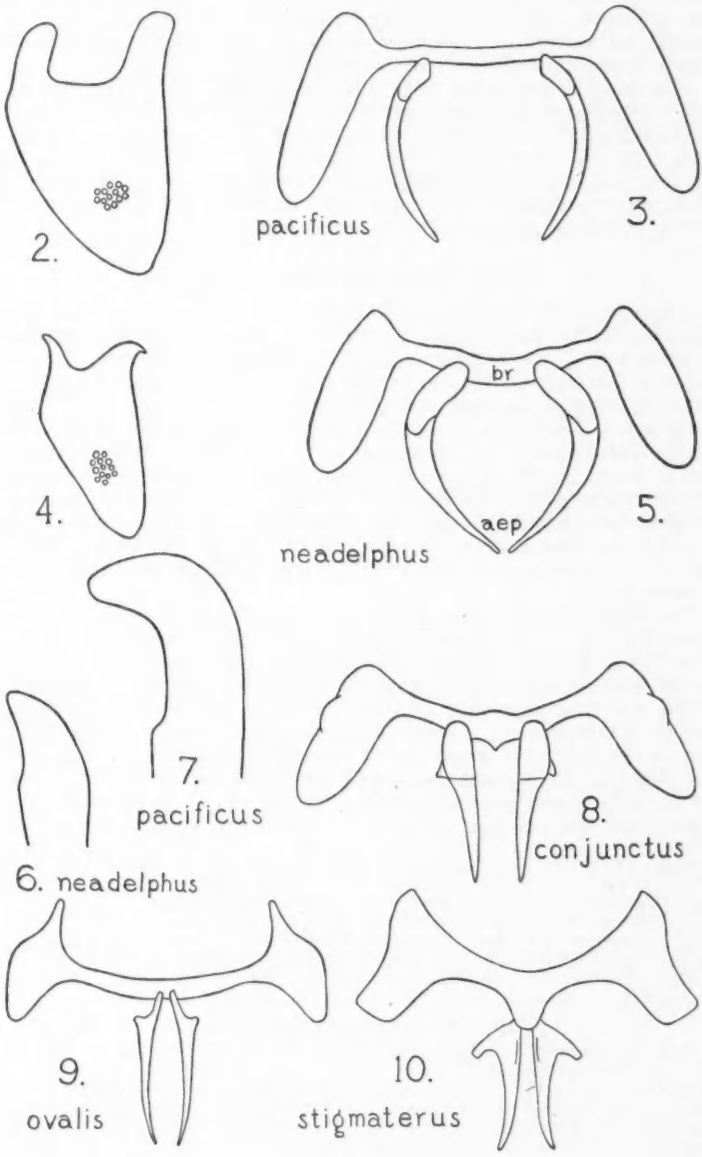
EXPLANATION OF PLATE I

(All drawings by the author.)

Fig. 2. *Hemerobius pacificus* Bks., male, lateral view of right anal plate. New Mexico (Transition Zone). Fig. 3. Same, *posterodorsal view* of sternum 10 and aedeagus. Same specimen as in fig. 2. Fig. 4. *H. neadephus*, male, same view as fig. 2. Yosemite Nat'l. Park, Calif. Fig. 5. Same, same view as fig. 3. Holotype. Fig. 6. Same, male, *posteroventral view* of ventral process of right anal plate. Logan, Utah. Fig. 7. *H. pacificus*, same view as fig. 6. Logan Utah. Fig. 8. *H. conjunctus conjunctus* Fitch, same view as fig. 3. Las Vegas, N. Mex. Fig. 9. *H. ovalis* Carp., same view as fig. 3. Logan, Utah. Fig. 10. *H. stigmaterus* Fitch, male, *posterior view* of sternum 10 and aedeagus. Lone Pine, Calif.

ABBREVIATIONS USED IN PLATES

ae—aedeagus.
aep—plates of aedeagus.
ap—anal plate.
br—bridge of 10th sternum.
MP—posterior branch of media.
p—process of anal plate.
pa—parameres.
pr—process of aedeagus.
rv—recurrent vein.
S9, S10—9th and 10th sterna.
T9—9th tergum.
x—next to lowest inner gradate vein.
y—MA-MP crossvein.
z—middle arm of parameres.


2.
pacificus
3.
4.
br
aep
5.
neadelphus
7.
pacificus
6. neadelphus
8.
conjunctus
9.
ovalis
10.
stigmaterus

sented by several specimens from New Mexico, where ***neadelphus*** is now unknown. The type locality of ***pacificus*** is Olympia, Wash. I have seen Californian males only from Lone Pine (Inyo County) and Cherry Valley (near Beaumont, Riverside County).

The male of ***neadelphus*** from Alhambra, Calif., bears data showing that it matured in February, 1918, from a larva reared on apple aphids and Cicadellidae: the egg was collected by W. M. Davidson on Jan. 26, 1918, from the previous season's foliage of an apple tree. Larvae of the closely related ***Hemerobius pacificus*** have often been recorded as predators of aphids, thrips, mites and other pests[4] and some of the records probably apply at least in part to ***neadelphus***.

Genus **Sympherobius** Banks

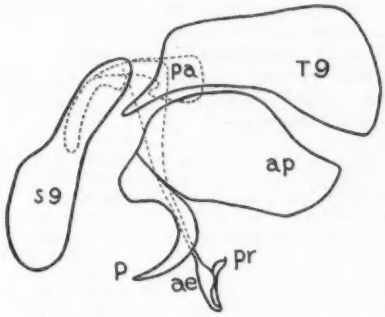
The new species here described, together with ***perparvus*** (McL.) and ***killingtoni*** Carp., comprise the known Nearctic members of what may be termed the "***perparvus group***." The outstanding feature of these species is that each anal plate of males bears a single process, not two or more processes as in other species. The parameres (figs. 18–23) are much alike. These species also agree in lacking a radial cross vein, though that character is not peculiar to them. Species with extremely narrow wings for the genus (***perparvus***, ***beameri***) and with only moderately narrow wings (***killingtoni***) are included. Two Nearctic species of ***Sympherobius***, ***arizonicus*** (Bks.) and ***pictus*** (Bks.), are known only from females, and they may be members of the group, though the shape and color markings of the wings readily distinguish them from ***beameri***, n. sp.

Genitalic characters that I have found most useful are the process of the anal plate and the process of the aedeagus. The parameres are so small and delicate that few distinctions may be made in them except for the nonexpanded middle arms of ***killingtoni***. Lateral views (figs. 21–23) are included mainly to show the close similarity of the three species in this respect. Certain differences that appear in the drawings, as the double or single line at the posterior margin of tergum 9 (figs. 12, 14, 16), are not considered important but rather to reflect the variable appearance of individual specimens. The aedeagus is a delicate structure of distinctive shape, somewhat loosely attached to

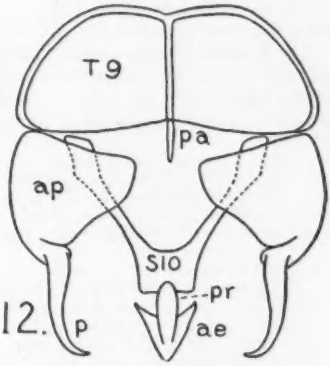
[4]The following are important references to *pacificus* as a predator:
Balduf, 1939 (The Bionomics of Entomophagous Insects, Pt. 2: 256–260).
Essig, 1926 (Insects of Western North America: 156–157).
Ewing, 1914 (Oreg. Agr. Expt. Sta. Bull. 121: 57).
Moznette, 1915 (Jour. Econ. Ent. 8: 350–354).
Quayle, 1912 (Calif. Agr. Expt. Stat. Bull. 234: 516–518); 1938 (Insects of Citrus and other Subtropical Fruits: 40–41).

EXPLANATION OF PLATE II

Fig. 11. *Sympherobius perparvus* (McL.), male, *lateral view* of apex of abdomen. Texas (Belfrage). (May be topotype, as Belfrage took type in Bosque Co., Tex.) Fig. 12. Same, *dorsal view* of apex of abdomen. Same specimen as in fig. 11. Fig. 13. *S. beameri*, new species, same view as fig. 11. Holotype. Fig. 14. Same, same view as fig. 12. Holotype. Fig. 15. *S. killingtoni* Carp., same view as fig. 11. Paratype, Williams, Ariz. Fig. 16. Same, same view as fig. 12. Same specimen as in fig. 15.



11. perparvus



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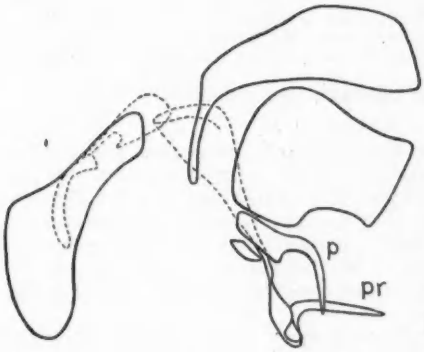
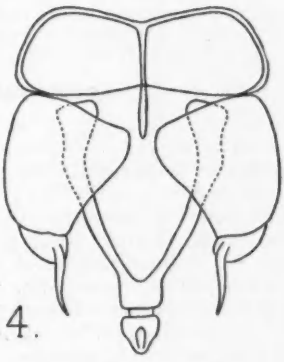


13. beameri



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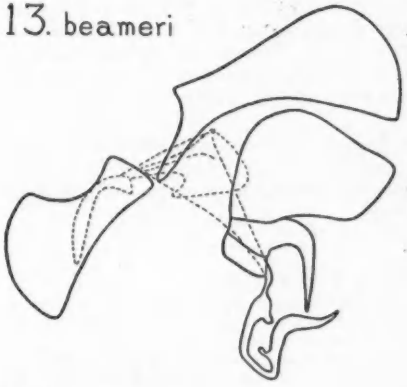
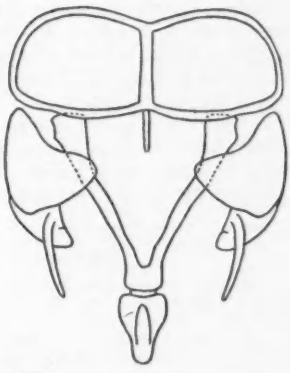


15. killingtoni



16.

the apex of sternum 10. For this reason the orientation of the aedeagus may differ if preparations are worn by excessive manipulation.

S. beameri shows closest relationship to *perparvus* in the wing shape and the shape of sternum 9 of the male, but more similarity to *killingtoni* in the form of the anal plate process. The three species of the *perparvus group* may be distinguished by the following key:

1. Front wing maculate, usually with more or less coalescing brown blotches, and with conspicuously and heavily brown margined gradate veins; front wing only moderately narrow for genus, the costal margin narrowed near distal end of subcosta to about one-half the greatest width; base of sternum 9 of male expanded (fig. 15); middle paramere arms not expanded (fig. 18) ..... **killingtoni**

   Front wing uniformly white, or ashy gray and maculate usually with well scattered blotches, gradates not margined, but may be darkened and often coincide with roundish or irregular brown or gray blotches; front wing decidedly narrow for genus (fig. 17), the costal field of more uniform width than above; base of sternum 9 of male not as above (figs. 11, 13); middle paramere arms expanded (figs. 19, 20) 2

2. Front wing immaculate; distal half of male anal plate process practically straight (figs. 13, 14); process of aedeagus straight and erect ..... **beameri**

   Front wing maculate with blotches; process of male anal plate conspicuously curved throughout its length in lateral view, moderately so in dorsal view (figs. 11, 12); process of aedeagus not straight and erect ..... **perparvus**

Sympherobius beameri, new species

(Figures 13, 14, 17, 20, 23)

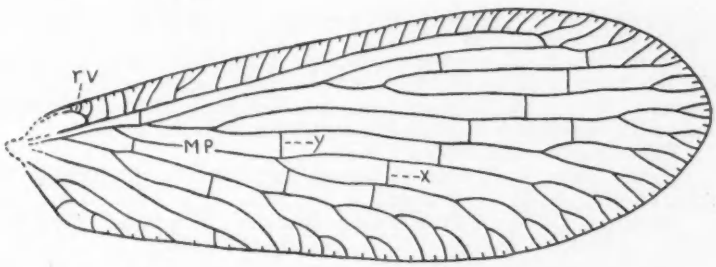
Male (*holotype*).—Small and unusually pale for genus. Front wing essentially as illustrated in paratype; in left wing the next to lowest inner gradate vein (fig. 17, x) only slightly nearer basal gradate than to next distal one above; in right wing next to lowest gradate nearer to one above than to basal gradate; in right wing MA-MP crossvein (fig. 17, y) briefly basad of fork of MP; recurrent vein (rv) and both gradate series weakly defined; radial crossvein absent. Hind wing slightly shorter than front wing.

Terminalia (figs. 13, 14, 20, 23): Tergum 9 with lateral extremity slender, noticeably elongate. Anal plate with posterior margin dorsad of process broadly concave; process single, apical half straight in lateral view, weakly incurved in dorsal view. Process of aedeagus erect, straight. Basal half of sternum 9 slender, scarcely expanded at point of tergal attachment. Parameres with tips of middle arms (fig. 20, z) conspicuously expanded.

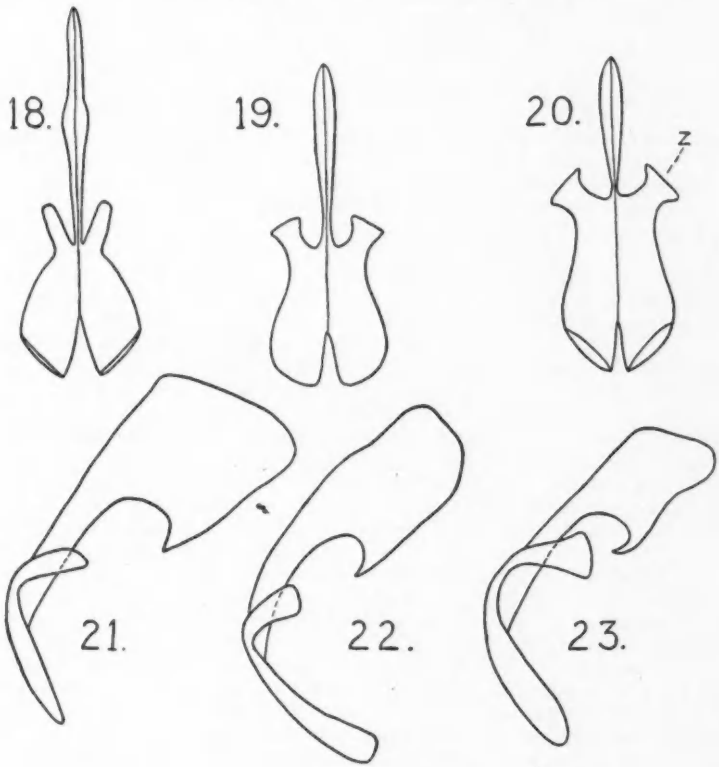
Coloration: General body color pale brown; pronotum somewhat darker; basal half of antennae slightly darker than distal half; eyes black; legs pale clay yellow; wings uniformly ashy white, longitudinal veins bearing trichia but unspotted.

EXPLANATION OF PLATE III

Fig. 17. *Sympherobius beameri*, new species, male, right front wing. Length, 3.6 mm. Paratype. Fig. 18. *S. killingtoni* Carp., male, *posterodorsal view* of parameres. Hansen, Idaho. Fig. 19. *S. perparvus* (McL.), same view as fig. 18. Same specimen as in fig. 11. Fig. 20. *S. beameri*, same view as fig. 18. Holotype. Fig. 21. *S. killingtoni*, *lateral view* of parameres. Same specimen as in fig. 18. Fig. 22. *S. perparvus*, same view as fig. 21. Same specimen as in fig. 11. Fig. 23. *S. beameri*, same view as fig. 21. Holotype.



17. Sympherobius beameri



killingtoni perparvus beameri

Measurements: Length of body, 3.5 mm.; of front wing, 3.6 mm.; width of front wing, 1.35 mm.

In addition to the type just described, there is one male paratype, the left front wing of which has the basal two inner gradates more separated than in the right wing (fig. 17). The gradates are also weakly darkened. Otherwise, there is full agreement with the type.

Type locality. Lake Tahoe, Calif.

Type. Male, University of Kansas, collected at type locality on Aug. 11, 1940, by R. H. Beamer.

Paratype. Male, United States National Museum, Type No. 58600, collected at Rosamond, Calif., on July 23, 1940, by D. E. Hardy.

The two localities are about 300 miles apart, one (Lake Tahoe) east of the high Sierras, the other (Rosamond) in the arid country of southern Kern Co., Calif., thus suggesting that *beameri* is probably widespread in California and Nevada.

A CLASSIFICATION OF NORTH AMERICAN CONOPIDAE

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New Haven, Connecticut

In the course of determining several lots of North American Conopidae, it soon became evident that there were considerably more names than species. Sixty-seven years age S. W. Williston, in his account of *Conops*, admonished that "the indiscriminate description of new species, is here especially to be deprecated; and, owing to the great individual variation of color, and the paucity of plastic characters, large collections will be essential, eventually, to a complete and satisfactory knowledge". Since Williston's advice has not been too well followed, the present paper is an attempt to clear up some of the difficulties and present a point of departure for future studies.

In a manner typical of many parasitic insects the species of Conopidae exhibit remarkable individual variation. This variability is not only sexual but includes many of the characters commonly utilized in defining species and even genera. Generic characters which may vary greatly are wing venation, ocelli, hairs, and length of palpi and proboscis. Specific characters of a variable nature are size, color, shape of antennae, and amount of pollen. For instance, in certain *Zodion* such as *obliquefasciatum*, Camras has recognized three phases: melanistic, rufous, and pollinose. Also, especially in *Physoconops* and *Physocephala*, boreal examples of a species tend to be smaller and darker, and the more austral specimens tend to be larger and more rufous than normally. Or these same tendencies may depend on the season.

All this specific variability has not been properly recognized in the past, with the result that too many names have been applied. Kröber and M. C. Van Duzee have been especially liberal in this respect. Following their species concept this writer (1940, Psyche, 47:27–37) described from the West Indies several species which now should probably be regarded as synonyms of the species with which they were compared. After studying Holarctic Conopidae in some detail, this writer arrived at a much more conservative concept of species, which is followed in the present work.

In 1939 Bohart and MacSwain published an account of rearing over 100 specimens of *Physocephala* from one nest of a Bembecid wasp. On examining this single rearing they found variations enough to include five of Van Duzee's species. Their evidence is here utilized as criteria for evaluating other variations to which names have been assigned. Consequently many species are here synonymized. In almost every case where Bohart or Camras have examined the types and placed the names in synonymy, this writer had previously done so in manuscript. Therefore, although the types of Van Duzee, Kröber, Bigot, and a few others were not studied, this writer feels justified in committing to synonymy many of the described species. Only in this way has it been possible to bring some workable order to the welter of names. Nevertheless, the present arrangement of species should be looked upon as tentative.

When habits, genitalia, etc. are studied, some of the relegated names may be raised to at least subspecific rank.

In the Conopidae the descrimination of species is complicated by distinct sexual dimorphism. The relative lengths of the antennal segments, the shape of the style, the length of the proboscis, and color may vary between the sexes and have led to much of the conflicting views on species limits. The more fundamental distinctions have been stated by Faulkner (1931).

The female has the fifth and seventh abdominal segments modified. Seven segments are distinctly visible and the eighth forms the tip of the abdomen. In all our genera (except *Sicus* and most *Myopa* the former herein excluded from the New World) the fifth segment is produced ventrally to a greater or less degree to form the structure termed by the

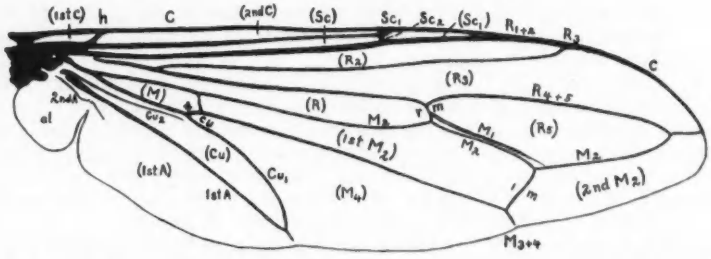

FIG. 1. Wing of *Physocephala tibialis* (Say). The system of nomenclature is that of Comstock-Needham (1918) emended by Tillyard (1919) and Alexander (1927, 1929). In addition a hitherto neglected vein is recognized as M_1 and is assumed to be homologous with the *vena spuria* of Syrphidae. The significant if more radical emendations proposed by Lameere (1922) and by Vignon and Séguy (1929, 1932) are not followed.

French writers apophase copulatrice, by Schiner 'unpaarige Organ', by Kröber 'Theca', by Szilady 'auffalenden Geschlechtdimorphismus', and by others the ventral or genital plate or process. In *Sicus* and many *Myopa* this structure is replaced by a tuft of hairs or bristles. In all our genera the seventh and eighth segments are prolonged in the shape of a shoe and curved to meet the genital plate in such a manner as to suggest a clasping organ. Both prolongations are lined with papillate pads, which are apparently modifications of the fifth, sixth, and seventh sternites.

The male tends to have a shorter abdomen with only six unmodified segments (five in Dalmanninae). The seventh and eighth segments are modified into a double cushion-shaped process underneath the fifth and sixth segments.

For the purpose of this paper the Neotropical species have been omitted. Since many more Mexican species range southwards into Central and South America than north into the United States, the most natural and convenient line of separation seems to be along the northern boundary of Mexico.

The writer is indebted to Professor Nathan Banks for the opportunity to study the excellent collection of Conopidae in the Museum of Com-

parative Zoology. There were found holotypes or paratypes of Loew, Banks, Robertson, and Camras, many cotypes and autotypes of Williston, and the type species of all the North American genera represented by series. For a similar privilege the writer is obligated to C. H. Curran (American Museum Natural History), E. A. Chapin (U. S. N. M. unfortunately only in part), M. T. James ;Colorado State College Agr. and Mech. Arts), R. L. Post (Oregon State College), H. E. Jaques (Iowa Wesleyan College;, and R. P. Dow (New England Mus. Nat. Hist.). For information on types the writer is indebted to Professor R. H. Beamer (Snow Entomological Collections) and Dr. H. Oldroyd (British Museum).

KEY TO SUBFAMILIES AND GENERA

1. Cubital (anal)[1] cell very small; ovipositor very long; pteropleura with a long bristle; vertex, lateral margins of dorsum of thorax, and scutellum with a few long, strong bristles; proboscis long and geniculate; third antennal segment with a subdorsal arista; tibiae spurred (Stylogastrinae), **Stylogaster** Macq.

   Cubital (anal) cell rather long and pointed; ovipositor not excessively long; pteropleura unarmed; vertex, lateral margins of dorsum of thorax, and scutellum without bristles, or with a few which are but little differentiated from the surrounding hairs; tibiae unarmed at apices 2

2. Third antennal segment with a three-segmented style at apex; abdomen constricted basally, the second and usually the third segments longer than broad; subcosta (Sc_1) and first branch of radius (R_{1+2}) connected by an apparent cross vein (Sc_2); halteres with some short hairs at base of knobs on outer side; ocellus usually vestigial or absent (present in *Physosonops*); proboscis directed forward, not geniculate (Conopinae) 3

   Third antennal segment with a dorsal two-segmented arista; abdomen not noticeably constricted basally, the second and third segments each broader than long; ocelli present; proboscis usually geniculate (directed forward in *Zodion* and *Robertsonomyia*) 5

3. Radio-medial (anterior) crossvein situated at most a little beyond the middle of the 1st M_2 (discal) cell; hind femora regularly thickened, the thickest part at middle; ocellus present, vestigial, or rarely absent; propleura with at least one bristle on lower margin 4

   Radio-medial (anterior) crossvein situated well beyond the middle of cell 1st M_2 (discal); hind femora irregularly thickened on basal half; ocellus absent; propleura bare ..... **Physocephala** Schiner

4. Ocellus on vertex distinct and protuberant, very rarely reduced (within a single species); first and second abdominal segments slender to very slender; third abdominal segment strongly constricted anteriorly to a width equal to that of second; second and third abdominal segments each distinctly longer than fourth; propleura almost always with one bristle at base, **Physoconops** Szilady

   Ocellus on vertex vestigial or absent, very rarely distinct; first and second abdominal segments only feebly constricted; second and third abdominal segments each about as long as the fourth; propleura usually with more than one bristle at base ..... **Conops** Linn.

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[1]The terms for wing nomenclature are those generally used in other insect orders and must be used in Diptera if we are ever to have a uniform system. The system followed here is that of Comstock-Needham (1918) with the modifications of Tillyard (1919) and Alexander (1927, 1929). Until they have been tested further, the radical emenations proposed by Lameere (1922), Vignon and Séguy (1929, 1932), and Goffe (1947) are not followed. The terms in parentheses are those heretofore utilized in the Conopidae. Consult the accompanying figure of the Conopid wing.

5. Cubital (anal) cell much longer than M (second basal) cell; female with the seventh abdominal segment large and shoe-shaped, the eighth much reduced; male with six unmodified abdominal segments (Myopinae)..... 6
Cubital (anal) cell but little longer than M (second basal) cell; female with seventh and eighth abdominal segments strongly narrowed and produced anteriorly to about the middle of abdomen; male with five unmodified abdominal segments (Dalmanniinae).....**Dalmannia** Rob.-Desv.

6. Proboscis produced anteriorly, not geniculate at middle, usually an apparent crossvein (Sc_2) connecting subcosta (Sc) and first branch of radius (R_{1+2}).. 7
Proboscis geniculate at or near middle as well as at base; usually no apparent crossvein (Sc_2) connecting subcosta (Sc) and first branch of radius (R_{1+2}), these veins sometimes slightly fused at apices..... 8

7. Femora without short thorns on apical half of antero-and postero-ventral surfaces; radial-five (first posterior) cell usually open, or closed at extreme apex; palpi very small, not longer than diameter of proboscis at their bases.....**Zodion** Latr
Femora with some short thorns on apical half of antero- and postero-ventral surfaces; radial-five (first posterior) cell long-stalked (rarely closed at apex, very rarely slightly open); palpi long, about three times as long as diameter or proboscis at their bases.....**Robertsonomyia** Malloch

8. Cheeks narrower than height of eye..... 9
Cheeks at least as wide as eye height.....**Myopa** Fabr.

9. Antennae longer than the front; propleura haired; abdomen short, especially in the female; hind coxae with some hairs on inner posterior margin, **Occemyia** Rob.-Desv.
Antennae shorter than the front; propleura bare; abdomen of female long and narrow; inner posterior margin of hind coxae bare (Palaearctic), **Sicus** Scop.

Genus **Conops** Linnaeus

Linnaeus, 1758, Syst. Nat. 10th ed., p. 604.

Genotype: ***Conops flavipes*** Linn., the fifth species, by designation of Curtis, 1831, Brit. Ent., p. 377. Subsequently Kröber chose as the genotype ***Conops macrocephala*** Linn., 1761, Fauna Suecia, p. 467.

Synonyms: ***Conopejus*** Rondani, 1845; ***Conopoideus*** Rondani, 1845; ***Pleurocerina*** Macquart, 1851; ***Conopilla*** Rondani, 1856; ***Sphyxosoma*** Rondani, 1856; ***Bombibia*** Lioy, 1864.

All the Nearctic and West Indian species heretofore placed under ***Conops*** belong in ***Physoconops***. Although Krober, 1939, lists some Neotropical species under ***Conops***, the only New World ***Conops*** the writer has seen is *C. **bermudensis*** Parsons (Psyche, 1940, 47: 28) of Bermuda.

Genus **Physoconops** Szilady

Szilady, 1926, Ann. Mus. Nat. Hungar., 24: 588.

Genotype: ***Conops brachyrhynchus*** Macquart.

The following species are here excluded from our lists. ***Conops? quadrimaculatus*** Ashmead, 1880, Orange Insects, p. 69, is listed under ***Conops*** by Aldrich (Suppl., 1907) and Van Duzee (1927) but is ***Baccha clavata*** Fabr. (Syrphidae). When Mr. Nathan Banks was shown Ashmead's description, he made the abode determination, which was confirmed on examination of specimens. C. W. Sabrosky has stated (in litt.) that there is no type of ***quadrimaculatus*** in the U. S. N. M. and that Dr. Aldrich places it as a synonym of ***Vaccha clavata*** in the card catalogue from the description alone. Macquart (1843) recorded

Conops costatus Fabr., *pictus* Fabr. and *analis* Fab. from "Caroline" and these species have been included in our lists ever since. The first was described from South America and apparently is still indeterminate. The second has been placed in *Physoconops* and restricted by the present writer (1940) to the Greater Antilles, from which it was described. The third has been placed in *Physocephala* by Kröber (1939) who gives the range as Mexico to Brazil. On the basis of specimens from southern Florida it is here included under *Physocephala* where it is discussed. Also Macquart (1843) described *Conops flaviceps* from "Amerique Septentrionale." It is a very small species and because of a brown spot at the apex of the wing may be one of the Neotropical *Physoconops* or *Physocephala*. An attempt has been made to place the species according to their affinities and they should so be arranged in the collection.

For keys and descriptions consult Williston (Trans. Conn. Acad. Arts & Sci. 1882, 4: 325–342; 1885, 6: 377–379).

Physoconops obscuripennis (Williston)

Conops obscuripennis Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 328–9.
Conops brachyrhynchus Macq., of Williston and others in error.
Conops foxi Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 574.

Types: of *obscuripennis* a single type from South Carolina in Snow Entomological Collections at Lawrence, Kans. (Williston also mentions Virginia, Georgia, and Massachusetts and so some Osten Sacken specimens in M. C. Z. may be cotypes); of *foxi* from Pullman, paratype from Metaline Falls, Washington, in Calif. Acad. Sci. Curran (Can. Ent. 59: 32) has pointed out that Williston was in error in calling this species *brachyrhynchus* and that Williston's *xanthopareus* is *brachyrhynchus* of Macquart. Since Van Duzee quotes Kröber in his key, he evidently did not have specimens which would have shown that his *foxi* must be identical. The M. C. Z. has specimens ranging from Mass. to Florida, west to Louisiana, Colorado, Nebraska, and Washington (Little Spokane). Others have been seen from Iowa, and it is recorded from B. C. by Kröber, from S. Dak. by Aldrich and N. M. by Townsend.

Physoconops sylvosus (Williston)

Conops sylvosus Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 329–330.
Conops arizonicus Banks, 1916, An. Ent. Soc. Amer. 9: 191–2.

Types: of *sylvosus* a single type from Massachusetts in the Snow Entomological Collections at Lawrence, Kans. (Williston also mentions Connecticut); of *arizonicus* holotype No. 13547 from Palmerlee, Arizona, in the M. C. Z.

Banks based *arizonicus* on a small female which differs from typical *sylvosus* in a smaller ventral plate, dark cloud on wing extending to cubitus, first branch (fifth vein), no pale bands on abdomen, and by the longer third antennal segment. Some of these differences do not hold in other specimens in the M. C. Z. from Arizona and Texas, which have been added since Banks wrote his description. Others of these differences disappear on examination of a series of eastern specimens. Also Williston has recorded *sylvosus* from Mexico (Guerrero) and

Giglis-Tos notes its occurrence in Tehuacan. The four Texan and Arizona specimens seen are all small but no smaller than some eastern specimens. It is evidently a very variable species. The M. C. Z. material ranges from Mass. to Virginia, Texas (Fort Davis) and Arizona (Palmerlee, Fort Grant, Dragon). The A. M. N. H. and New England Mus. N. H. have specimens from Franconia, N. H.

Physoconops semifuscus (Banks)

Conops brachyrhynchus var. *semifuscus* Banks, 1916, Ann. Ent. Soc. Amer., 9: 192.

Type: holotype No. 13546 collected July 6, Jemez Springs, New Mexico, in the M. C. Z.

As Mr. Banks indicated, this species is related to ***obscuripennis***, but it has a longer ventral plate, a slightly longer third antennal segment, paler femora, humeri yellow pollinose, and differently colored wings.

Physoconops bulbirostris (Loew)

Conops bulbirostris Loew, 1853, Neue Beitrage Kennt. Dipt., p. 30.

Type: from an unknown locality presumably in the Berlin Museum, referred to North America by Osten Sacken.

The M. C. Z. series range from New Jersey to Florida. Kröber records it from Texas, Mexico, Bolivia, Brazil, and Paraguay.

Physoconops nigrimanus Bigot

Conops nigrimanus Bigot, 1887, Ann. Soc. Ent. France, p. 38.
Conops limuva Brimley, 1927, Ent. News, 38: 235.

Types: of ***nigrimanus*** from Georgia in the collection of J. E. Collins, England; of ***limuva*** (not seen) from Raleigh, N. C., in the collection of the N. C. Dept. of Agriculture.

Descriptions of the two species agree closely and especially with respect to a yellow spot (sometimes obscure) behind the vertex, a characteristic not found in any other of our species. The M. C. Z. has a small series from New Jersey, that were mixed in with ***bulbirostris***. Known also from North Carolina and Georgia.

Physoconops fronto (Williston)

Conops fronto Will., 1885, Trans. Conn. Acad. Arts & Sci. 6: 378–9.
Conops striatifrons Kröber, 1915, Arch F. Naturg, Abt. A. H. 5, p. 132.
Conops pulchellus Kröber, 1915, Arch F. Naturg. Abt. A. H. 5, p. 134.
Conops argentifacies Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 574–5.
Conops fraterculus Van Duzee, 1927, loc. cit., p. 575–6.
Conops rubicundulus Van Duzee, 1927, loc. cit., p. 576–7.

Types: of ***fronto*** three cotypes from western Kansas in the Snow Entomological Collections at Lawrence, Kans., autotype from Umatilla, Or., in M. C. Z.; of ***striatifrons*** from Georgia and Texas in the Berlin Museum, allotype from Lincoln, Nebraska, in the Kröber collection, Hamburg; of ***pulchellus*** from South Carolina in the Vienna Museum; of ***argentifacies***, ***fraterculus***, and ***rubicundulus*** all from Lewiston, Idaho, and in the Calif. Acad. Sci.

Since Kröber merely quoted Williston's description, he evidently did not understand this species and so described specimens from the West and East as two new species. Since Van Duzee keyed *fronto* from the description and gives only Kansas as the distribution, he also did not know *fronto*. His description of *argentifacies* agrees exactly with a specimen from Oregon in the M. C. Z. identified as *fronto* by Williston. The differences Van Duzee ascribes to *fraterculus* and *rubicundulus* fall well within the range of variation of *fronto*. Bohart and MacSwain (1940, Pan-Pacific Ent. 16: 91) record *argentifacies* as a parasite of *Megachile perihirta* Cockerell.

The M. C. Z. has specimens from Oregon, Colorado, Nebraska, New Mexico, Texas, and one from Cambridge, Mass. Additional localities represented in the A. M. N. H. are Lusk, Wyo., Antioch, Calif., and one from Valdosta, Georgia, is aberrant in having the posterior portion of the abdomen uniformly dark and nearly as dark as the anterior portion.

Physoconops brachyrhynchus (Macquart)

Conops brachyrhynchus Macquart, 1843, Dipt. exot. 2: 15.
Conops xanthopareus Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 332–3.
Conops fenestratus Kröber, 1915, Arch. F. Naturg. Abt. A. H. 5, p. 134–5.

Types: of *brachyrhynchus* from "Amerique septentrionale" probably in the Mus. Hist. Nat., Lille; of *xanthopareus* a specimen labelled "Type Wlstn 441" in the M. C. Z. and a cotype from Connecticut in the Snow Entomological Collections at Lawrence, Kans. (since Williston also mentions Texas and Massachusetts, some of Osten Sacken's specimens in M. C. Z. may be cotypes); of *fenestratus* from Lincoln, Nebraska, paratypes from Texas, Delaware, and Louisiana in the Berlin Museum.

Williston did not attempt to apply Macquart's name to any of the material before him and so described his material as new. But Macquart's description and figures leave no doubt of the above synonymy. Kröber's description fits this species, and there even are specimens of *brachyrhunchus* in the M. C. Z. with data identical with that of some of Kröber's paratypes. Also the Mexican *soror* Kröber is very likely this species.

The M. C. Z. has material ranging from Mass. to Florida, west to Texas, Kansas, Nebraska, and Colorado. Others have been seen from Iowa and Kröber records it from southern Arizona.

Physoconops gracilis (Williston)

Conops gracilis Will., 1885, Trans. Conn. Acad. Arts & Sci. 6: 377.

Type: holotype from Arizona in the Snow Entomological Collections at Lawrence, Kans.

Kröber (1939) placed *gracilis* in *Conops*, possibly because the ocellus tends to be reduced in this species, but more probably because his 1939 identification was incorrect as in 1915.

The M. C. Z. material is from Florida, Colorado, New Mexico, Arizona, and Lower California. Kröber records it from Chile and Brazil, but since his 1915 description of *gracilis* applies to *auratus*, these localities may belong to *auratus*.

Physoconops auratus (Townsend)

Conops auratus Towns., 1901, Trans. Am. Ent. Soc. 27: 161–3.

Type: La Cueva, 5300 ft., Organ Mts., New Mexico, cannot be found in the British Museum, U. S. N. M., or Snow Entomological Collections.

The M. C. Z. has a pair from Bill William's Fork, Arizona, and the A. M. N. H. has it from the same locality and also Douglas, Arizona. All the dates of capture are later than usual in the genus, being in August and September. Kröber (1915) records *auratus* from Kansas, Texas, and Mexico, and his description fits *auratus*. But his more complete description of *gracilis* also fits *auratus*; so perhaps the record of Arica, Chile belongs to the latter. Kröber (1927) records *auratus* from Texas and Missouri, but since he states that the ventral plate is small and broad, he has some other species before him.

Physoconops excisus (Wiedemann)

Conops excisus Wied., 1830, Auss. Zweifl. Ins. 2: 234.
Conops sugens Wied., 1830, Auss. Zweifl. Ins. 2: 236.

Types: of *excisus* from Savannah, Georgia, in the Zool. Mus. at Copenhagen (Westermann coll.); of *sugens* from unknown locality in the Vienna Museum.

Loew, having seen both types and compared Mexican specimens with *sugens*, made the above synonymy. The M. C. Z. has two from Florida determined by Loew and others ranging from New York (Long Island) and New Jersey to Florida west to Ohio and Mississippi.

Genus **Physocephala** Schiner

1861, Wiener, Entom. Monatsschr. 5: 137–138.

Genotype: *Conops rufipes* Fabr., monobasic.

Kröber (1939) gives the genotype as *Conops nigra* Deg., 1776, Ins. 6: 105, t. 15, f. 9.

Bohart (1941) Pan-Pacific Ent. 17: 141–4) in a review of the *Physocephala* of the western United States treats two species, *affinis* and *burgessi*. In this paper *affinis* is made a synonym of *texana* and two more species are added to the western fauna, also one to the United States, and several names are synonymized.

For keys and descriptions consult Williston (Trans. Acad. Arts & Sci. 1882, 4: 327–328, 333–342.

Physocephala burgessi (Williston)

Conops burgessi Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 337–8.
Conops brevirostris Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 579–580.
Physocephala brevicornis Bohart, 1941, Pan-Pacific Ent. 17: 144, lapsus.

Types: of *burgessi* one from Mendocino "Calif. Baron Type Wlstn 441" in the M. C. Z., three cotypes same data in Snow Entomological Collections at Lawrence, Kansas (Williston also mentions Colorado); of *brevirostris* from Plumas Co., Calif., in the Calif. Acad. Sci.

The synonymy follows Bohart (1941). This species is represented in the M. C. Z. from Wash., Oregon, Calif., Colo., and Wyoming. It is also recorded from New Mexico by Skinner, from Utah, Idaho, and Montana on flowers of *Prunus* and *Ceanothus* by Bohart.

Physocephala texana (Williston)

Conops texanus Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 338.
Conops affinis Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 339–340.
Conops ochreiceps Bigot, 1887, Ann. Soc. Ent. France, 7: 39–40.
Physocephala humeralis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 580–581.
Physocephala humeralis simulans Van Duzee, loc. cit., p. 581.
Physocephala aurifacies Van Duzee, loc. cit., p. 581–582.
Physocephala buccalis Van Duzee, loc. cit., p. 582–583.
Physocephala rubida Van Duzee, 1934, Ann. Ent. Soc. Amer. 27: 315–316.

Types: of *texana* from Waco, Texas, 3 cotypes in U. S. N. M. (No. 882); of *affinis* a single type from Washington Territory in the Snow Entomological Collections at Lawrence, Kans., (Williston also mentions Kansas and California so specimen from "Cal." in M. C. Z. may be cotype); of *ochreiceps* from Georgia and Mexico in the collection of J. E. Collin, England; of *humeralis* from Idaho, of *simulans* holotype from Calif., paratypes from Utah, Idaho, Wash., of *aurifacies* from California, of *buccalis* holotype from Utah, paratypes from Calif., and Wash. in Calif. Acad. Sci.; of *rubida* from Oregon in the collection of W. W. Barker, Puyallup, Wash.

Some of the Neotropical names very likely will be found to belong to this very variable species. Since Bohart reared over 100 specimens from a single nest of Bembecid wasps and found variations enough to include all five of Van Duzee's species, the other names are invalid also. The M. C. Z. has it from Indiana, N. Mex., Ariz., Calif., Colo., Utah, Oregon, and Wash. It is also recorded from Georgia by Bigot, from Kansas and Texas by Williston, from Idaho by Van Duzee, from Mexico by Bigot and Giglio-Tos, and from Montreal, Quebec by Chagnon. Townsend's Michigan record is evidently of *marginata*. Under the name *affinis* Bohart and MacSwain (1939, Bull. So. Calif. Acad. Sci. 38: 84 and 1940, Pan-Pacific Ent. 16: 16) have recorded this species as a parasite of *Bembix comata* Parker and *Bembix occidentalis beutenmuelleri* Fox.

Physocephala marginata (Say)

Conops marginata Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 82–83.
Conops sagittaria Say, 1823, loc. cit. 3: 83.
Conops aethiops Walker, 1849, List. of Dipt. Ins. in B. M., Pt. 3, p. 671.
Conops genualis Loew, 1853, Neue Beitrage, 1: 32.
Conops castanoptera Loew, 1853, loc. cit. p. 33.
Conops ruficornis Van Duzee, 1934, Ann. Ent. Soc. Amer. 27: 315–6.
Conops dakotennis Van Duzee, 1934, loc. cit. p. 317–8.
Conops stylifer Van Duzee, 1934, loc. cit. p. 318–9.

Types: of *marginata* from Missouri is lost; an almost certain cotype is in the Vienna Museum (Wiedemann coll.); of *sagittaria* from Pennsylvania is lost; of *aethiops* from North America in the B. M.; of *genualis* a male from N. A. in the Vienna Museum and a female No. 439 from Kentucky in the M. C. Z.; of *castanoptera* a male from Savannah,

Georgia, and a female from Carolina, both in the Berlin Museum; of *ruficornis*, *dakotensis*, and *stylifer*, all reared from honey bees at Fargo, North Dakota, and in the collection of W. W. Barker, Puyallup, Washington.

This very variable species may be black or pale rufous. The cell 1st M_2 (discal) may be mostly hyaline (*marginata*), or entirely dark (*sagittaria*), or intermediate; when the cheeks are pale or when the face is brownish, the pale spot on cheek is barely noticeable (*genualis*). Southern specimens are much more rufescent (*castanoptera*). Since Van Duzee states that the first and second antennal segments are of nearly equal length, he evidently did not know *marginata*. The differences to which Van Duzee gives names are too minor to recognize.

The M. C. Z. has specimens ranging from Massachusetts to Florida west to Texas, and one from Corvallis, Oregon. The A. M. N. H. has it also from St. Anne's, Quebec; Ottawa, Kansas; Lander, Wyo.; and Nicola Valley, B. C. Also it is recorded from "Missouri" by Say, from the White Mts., N. H., by Williston, and from Michigan by Townsend, under *affinis*.

Physocephala furcillata (Williston)

Conops furcillata Will, 1882, Trans. Conn. Acad. Arts & Sci. 4: 336–7.
Physocephala sorocula Will., 1892, Biol. Centr.-Amer. Diptera, 3: 83.
Physocephala lucida Van Duzee, 1931, Can. Ent. 63: 284.

Types: of *furcillata* one from "Jefferson, N. H., Aug. 1, 1877, Type Wlstn 441" in the M. C. Z. and 3 cotypes from "White Mts." in the Snow Entomological Collections at Lawrence, Kans.; of *sorocula* from Guerrero, Mexico, in the B. M.; of *lucida* from Gull Lake, Ontario, in the Calif. Acad. Sci.

Evidently the hiatus between New Hampshire and Guerrero led Williston to describe *sorocula*, the name with which Van Duzee compared his *lucida*. A remarkably constant species, the one rufous specimen seen is from Pt. Pelee, Ontario. The M. C. Z. has *furcillata* ranging from Nova Scotia, Quebec, Ontario, and Michigan south to New Jersey, also Colton, San Bernadino Co., California, and Juan Mina, Rio Chagres, Panama Canal Zone. Also it is in the A. M. N. H. from Price Co., Wisconsin, and Williston recorded it under *sorocula* from Guerrero, Mexico.

Physocephala tibialis (Say)

Conops tibialis Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 83.
Conops nigricornis Wied., 1830, Auss. Zweifl. Ins. 2: 236.
Conops fulvipennis Macq., 1843, Dipt. Exot. 2: 13–14.
Conops lugubris Macq., 1843, loc. cit. p. 16.

Types: of *tibialis* from Indiana is lost; of *nigricornis* from Pennsylvania in the Vienna Museum; of *fulvipennis* from Georgia presumably in the Mus. Hist. Nat. at Lille; of *lugubris* from an unknown locality, a male (not female as Macquart says) is in the B. M.

Macquart's descriptions and figures agree so closely with this species, that it seems safe to place his names in synonymy, especially since arriving at this decision the writer has noticed that Kröber (1939,

Ann. Mag. Nat. Hist. 4: 540–1) states that the male type of *lugubris* is in London and is a synonym of *tibialis*. Rarely the extremities of the radial-three (submarginal), radial-five (first posterior), and 1st M_2 (discal) cells tend to become hyaline, and pollen near the humeri is usually very obsolete. The M. C. Z. has *tibialis* ranging from Massachusetts to Florida, west to Dallas, Texas and Baldwin, Kansas.

Physocephala analis (Fabricius)

Conops analis Fabr., 1775, Syst. Ent. p. 175.
Conops nigrifacies Bigot, 1887, Ann. Soc. Ent. France, 7: 40–41.
Conops carbonarius Bigot, 1887, loc. cit. p. 42.

Types: of *analis* from South America possibly at Kiel; of *nigrifacies* and *carbonarius* from Mexico in the B. M.

Krōber (1939, p. 460) places *carbonaria* as a synonym of *analis* and *nigrifacies* ("nigrofacies") as a doubtful synonym. Unfortunately some of Krōber's characters contradict the descriptions. Williston (1892) redescribes both of Bigot's species but is not sure of his identifications. H. Oldroyd writes that the type of *nigrifacies* is placed in the B. M. as a synonym of *analis*, and that the type of *carbonarius* is "similar in appearance, but bigger and blacker." The latter is evidently considered distinct. The M. C. Z. has a male from Florida (Pinecrest, July 19, G. Fairchild) which differs from the description of *nigrifacies* in being much larger, lacking the golden pollen on front, face, and cheeks, and the 1st M_2 (discal) cell entirely dark. It agrees with *carbonaria* in size, but differs in the dark facial grooves, and the dark 1st M_2 (discal) cell. A female from Mexico (M. C. Z.) differs principally in having a yellow face, coxae and tarsi pale, thorax and halteres black, and apical half of 1st M_2 (discal) cell hyaline. In the U. S. N. M. are two females from Florida (one from Haulover, March 9, and the other from Crescent City). These agree with the Pinecrest specimen except that the basal enlargement of proboscis is pale, face yellow with central black on each side, femora reddish brown. It is hard to believe that the sexes described under *carbonaria* by Bigot, Williston and Krōber really belong to the same species.

The Pinecrest male is here diagnosed. Length without antennae 17 mm.; head black, except vertex, margins of face, lower part of facial grooves, and antennae which are reddish brown; antennal segments (minus style) as 3 : 10 : 5; style with second segment nearly twice as long as first two combined; proboscis black, twice as long as head; thorax reddish brown with three black stripes above, covered with very fine grey pollen, no lateral stripe of pollen, halteres yellow; legs reddish brown, coxae, basal halves of hind femora, and apical two-thirds of tarsi black; abdomen black, first two segments brownish, apex covered with very fine grey pollen; wings with dark brown stripe extending to vein Cu_1 (fifth) and narrowly along 1st A vein (sixth).

Genus **Dalmannia** Robineau-Desvoidy

Rob.-Desv., 1830, Essai sur les Myodaires in Mem. Divers. Savans Acad. Roy. Sci. Inst. France (Sci. Math. Phys. 2: 248).

Genotype: *Myopa punctata* Fabr., the third species, by designation of Rondani, 1856, Dipt. Ital. Prodr. 1: 59.

Synonyms: *Stachynia* Macquart, 1833; *Arpagita* Lioy, 1864.

G. E. Bohart (1938) has published a key to the North American species (Pan-Pacific Ent. 14: 132–136). His habitat data is not repeated, but supplementary data is added.

Dalmannia vitiosa Coquillett

Dalmannia vitiosa Coq., 1892, Ent. News, 3: 150–151.

Type: from Los Angeles Co., California, in the U. S. N. M.

Bohart records material from Sonoma and Orange Counties, Calif., and Kansas. The M. C. Z. has it ranging from New Hampshire to Virginia, also Pinaleno Mts., Arizona. The A. M. N. H. has this species from Fallon, Nevada, and also a male from Globe, Arizona, which is aberrant in having the cross-vein nearly normal, a yellow spot on each humerus, and the antennae black with the third segment shorter than usual.

Dalmannia picta Williston

Dalmannia picta Will., 1883, Trans. Conn. Acad. Arts & Sci. 6: 94.

Type: a single type from New Mexico in the Snow Entomological Collection at Lawrence, Kans.

Bohart records this species from the Chiricahua Mts., Ariz., and Mohave, Calif. The M. C. Z. has *picta* from Colorado and California (Claremont, Redlands).

Dalmannia blaisdelli Cresson

Dalmannia blaisdelli Cresson, 1919, Proc. Acad. Nat. Sci., Philad. 71: 190.

Type: from Colorado in the Philad. Acad. Nat. Sci.; paratype from Mokelumne Hill, Calaveras Co., Calif. in Calif. Acad. Sci.

Bohart gives the California record as the type locality but Mr. E. T. Cresson, Jr., kindly re-examined the type and states that it is from Colorado. Bohart adds several California records. The M. C. Z. has it from California and Ft. Collins, Colorado, and the A. M. N. H., from Boulder and Walden, Colorado.

Dalmannia nigriceps Loew

Dalmannia nigriceps Loew, 1866, Berlin Ent. Zeitsch., 10: 40; Centuriae VII, p. 100–101.

Type: holotype No. 449 from Virginia in the M. C. Z.

Bohart saw specimens from Holliston, Mass. The M. C. Z. has this species ranging from Vermont to Virginia west to Lincoln, Nebraska. The New England Mus. N. H. and A. M. N. H. have it from Franconia, N. H., and the latter also from Aylmer; Quebec.

Dalmannia pacifica Banks

Dalmannia pacifica Banks, 1916, Ann. Ent. Soc. Amer. 9: 199–200.
Dalmannia hirsuta Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 591.

Types: cotype No. 13545 of *pacifica* from Corvallis, Oregon, in the M. C. Z. and cotype in collection of Oregon Agric. College; of *hirsuta* from Corvallis, Oregon, in the Calif. Acad. Sci.

Bohart, who examined the type of *hirsuta*, states that it is the female of *pacifica*. He records specimens from Berkeley and Davis, California. The M. C. Z. has another example from Springfield, Oregon. The A. M. N. H. has a series from Davis, Calif., taken on the unusually late date of July 2. Two of these have the yellow markings reduced.

Dalmannia heterotricha G. Bohart

Dalmannia heterotricha G. Bohart, 1938, Pan-Pacific Ent., 14: 134–135.

Type: from Pt. Reyes Peninsula, Marin Co., Calif., in Calif. Acad. Sci. This species, found on the sand dunes, has not been seen by the writer.

Genus **Myopa** Fabricius

Fabricius, 1775, Syst. Ent., p. 798.

Genotype: *Conops buccata* Linn., the sixth species, by designation of Curtis, 1838, Brit. Ent., vol. 8, p. 677, pl. 677. Kröber (1939) subsequently designated as the genotype *Conops testacea* Linn., 1759, Syst. Nat., ed 11, 2: 1006.

Synonyms: *Fairmairia*, *Haustellia*, *Lonchopalpus*, *Myopella*, *Myopina*, *Phorosia*, *Pictinia*, *Purpurella* all by Rob. Desv., 1853; *Gonirhynchus* Rond., 1857.

A character of generic importance, omitted by American and denied by European writers, is that the fifth ventral segment of the female is produced, as in the other genera (except *Sicus*). It is true that in the few European species examined (including the genotype) and over half of the North American species the fifth segment is not produced at all or very slightly. This condition is true in *melanderi*, *vicaria*, *fenestratus*, *willistoni*, *seminuda*, *rubida*, *clausa*, and *aperta*. But in the following species the ventral plate is greatly produced so that it attains or overlaps the apex of the eighth segment: *vesiculosa*, *varians*, *longipilis*, *flavopilosa*, *plebeia*, and *virginica*. Since the produced ventral plate is the most distinctive character of *Melanosoma* Rob.-Desv., 1853 (*Gossigona* Rondani, 1856), this writer attempted to place the North American species with this character in *Melanosoma*. But an examination of a series of the genotype (*bicolor* Meig.) in the M. C. Z. shows *Melanosoma* to differ in other ways, particularly in a distinctly longer proboscis and tubular abdomen as described by Schiner (1862, pp. LXVII, 383). Possibly one of the above listed synonyms is available.

Descriptions of most of the species will be found in two papers, one by Williston (Trans. Conn. Acad. Arts & Sci. 1885, 6: 382–387) and one by Banks (Ann. Ent. Soc. Amer. 9: 196–198).

Myopa melanderi Banks

Myopa melanderi Banks, 1916, Ann. Ent. Soc. Amer. 9: 197.

Type: holotype No. 13551 and paratype from Pullman, Washington, in the M. C. Z.

Of this species all that has been seen is the type, allotype, and one other specimen all collected in May and June at Pullman, Washington.

Myopa vicaria Walker

Myopa vicaria Walker, 1849, List. of Dipt. Ins. in B. M. 3: 679.
Myopa pilosa Will., 1885, Trans. Conn. Acad. Arts & Sci. 6: 383–4.

Types: of *vicaria* from Nova Scotia in the British Museum; of *pilosa* a single type from Kern Co., California, in the Snow Entomological Collection at Lawrence, Kans.

The M. C. Z. has this species ranging from Nova Scotia to Virginia west to Illinois and Michigan, also one from Pullman, Washington. Others have been examined from Oregon (Or. State College) and the following in the A. M. N. H.: Ontario, Quebec, Wyoming, and Arizona. Specimens from England and Sardinia (A. M. N. H.) are identical.

Myopa fenestrata Coquillett

Myopa fenestrata Coq., 1902, Can. Ent. 34: 197–8.

Type: from 7300 ft., Sierra Madre, Chihuahua, Mexico, in the U. S. N. M.

Kröber (1939) omitted this species, which is likely to turn up in our southwestern states. The M. C. Z. has a female from Amecameca, Mexico.

Myopa willistoni Banks

Myopa pictipennis Will., 1885, Trans. Conn. Acad. Arts & Sci. 6: 382–3 (nec *pictipennis* Rob.-Desv., 1830).
Myopa willistoni Banks, 1916, Ann. Ent. Soc. Amer. 9: 197.

Type: one specimen labelled "Type Wlstn Cal 447" in the M. C. Z., 3 cotypes from California and one from Arizona in the Snow Entomological Collections at Lawrence, Kans.

The M. C. Z. has *willistoni* from California and Mary's River, Oregon, and the A. M. N. H. has it taken in March at Globe, Arizona. Giglio-Tos records it from Toluca, Mexico.

Myopa vesiculosa Say

Myopa vesiculosa Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 80.
Myopa apicalis Walker, 1849, List of Dipt. Ins. in B. M. 3: 679.
Myopa bistria Walker, 1849, loc. cit. p. 679–680.
Myopa conjuncta Thomson, 1868, Eugenies Resa, Diptera, p. 515–6.
Glossigona maculifrons Bigot, 1887, Ann. Soc. Ent. France, 7: 206–7.

Types: of *vesiculosa* from Pennsylvania is lost; of *apicalis* and *bistria* from North America in the British Museum; of *conjuncta* from California in the National Museum, Stockholm; of *maculifrons* from Nevada in the collection of J. E. Collin, England. Walker's *bistria* is placed here with considerable doubt.

The M. C. Z. has this ranging from New Hampshire to Virginia, west through Texas and Nebraska to Washington. The A. M. N. H. has it also from Quebec and Kansas.

Myopa varians Banks

Myopa vesiculosa var. *varians* Banks, 1916, Ann. Ent. Soc. Amer. 9: 196.

Type: holotype No. 13548 from Lincoln, Nebraska (April) in the M. C. Z.

Since *varians* seems to be constant, it may be raised to specific rank. A series from Colorado was received from M. T. James, but no *vesiculosa* were included. An exception is a specimen collected May 30, at Chicago, Illinois (A. M. N. H.) which approaches *varians*, whereas another specimen with the same data is typical *vesiculosa*. In *varians* the abdomen tends to be pale red; the dark cloud in center of wing is usually less distinct than in *vesiculosa*; also the length of body and antennae averages shorter than in *vesiculosa*.

Myopa longipilis Banks

Myopa longipilis Banks, 1916, Ann. Ent. Soc. Amer. 9: 197.

Type: holotype No. 13550 from Pullman, Washington, in the M. C. Z.

In addition to the type the M. C. Z. has one from California which is doubtfully this species, and one from Oregon, part of a series from the Oregon State College. It is in the A. M. N. H. from Antioch and Palo Alto, California.

Myopa flavopilosa Kröber

Myopa flavopilosa Kröber, 1916, Arch. Fur Naturgesch. (1915) Abt. A, H. 7, p. 30–31.

Type: from southern Colorado in the Vienna Museum.

The M. C. Z. has this collected the same day as an example of *rubida* at Elsinore, Utah, also one of three taken at Boulder and Rist Canyon, Colorado, M. T. James. Except for the hair it is very close to *vesiculosa*.

Myopa virginica Banks

Myopa virginica Banks, 1916, Ann. Ent. Soc. Amer. 9: 198.

Type: holotype No. 13552 from Falls Church, Virginia, June 15, paratypes from North Carolina (Black Mt.), Virginia (Falls Church and Glencarlyn), and New York (Catskill Mts.) in the M. C. Z.

This species is in the M. C. Z. ranging from Connecticut to North Carolina west to Michigan. It is in the New England Mus. N. H. from Vermont. Three specimens from the Catskill Mts., June (A. M. N. H.) are larger and have longer hair than usual.

Myoba plebeia Williston

Myopa plebeia Will., 1885, Trans. Conn. Acad. Arts & Sci. 6: 384–5.
Gonirhynchus castaneus Bigot, 1887, Ann. Soc. Ent. France, 7: 207–8.

Types: of *plebeia* three cotypes from Arizona in the Snow Entomological Collection at Lawrence, Kans.; of *castaneus* from Nevada in the collection of J. E. Collin, England.

The M. C. Z. has *plebiea* from Washington, California, and New York. The specimen from New York has the two basal tergites red and differs somewhat in other ways. It is in the A. M. N. H. from Arizona and California.

Myopa seminuda Banks

Myopa seminuda Banks, 1916, Ann. Ent. Soc. Amer. 9: 198.
?*Glossigona rubida* Bigot, 1887, Ann. Soc. Ent. France, 7: 206.

Types: of *seminuda* holotype No. 13549 from base of Mary's Peak, Oregon, (May 14) in M. C. Z. paratypes from same locality and Cor-

vallis, Or., in M. C. Z. and Oregon State College; of ***rubida*** from Colorado in the collection of J. E. Collin, England.

If ***rubida*** should prove to be conspecific with ***seminuda*** then, as the older name, it will take priority. The description of ***rubida*** also applies to ***aperta***. See under ***curticornis*** for a further discussion of ***rubida***. The M. C. Z. has ***seminuda*** from Washington, Oregon, California, Idaho, and Colorado, June–Sept., where it is evidently the commonest ***Myopa***. The A. M. N. H. has it also from Wyoming. Specimens with slightly longer hair than usual and cell R_5 (first posterior) narrowly open instead of closed at apex should perhaps be placed under ***aperta*** Röder. Under the name ***rubida*** Bigot this species is recorded as a parasite of several species of ***Andrena*** by Bohart (1941, Pan-Pacific Ent. 17: 95–96).

Myopa curticornis Kröber

Myopa curticornis Kröber, 1916, Arch. fur Naturg. (1915), Abt. A, H. 7, p. 32.

Types: from Colorado and California in Mus. Civ. Stor. Nat. (Bezzi coll.) at Milan.

Banks (1916) applied the name of ***Glossigona rubida*** Bigot to a western species that resembles ***clausa*** but has a distinctly shorter proboscis and antennae. Since Bigot placed ***rubida*** in ***Glossigona***, which has a produced ventral plate, the name ***rubida*** cannot be applied to the present species. Kröber's ***curticornis***, which is much more definitely, described, is then available. Van Duzee (1927), evidently misled by the two types of ventral plate in **Myopa**, thinks ***curticornis*** should perhaps go into ***Sicus***. The M. C. Z. has this species from Washington, California, Utah, Colorado, and Maine. Others have been seen from Colorado (Col. State Coll.) and Oregon (Or. State Coll.).

Myopa clausa Loew

Myopa clausa Loew, 1866, Centuriae VII, no. 72, p. 101.

Type: holotype No. 448 from Maine in the M. C. Z.

Williston (1885) included (perhaps correctly) specimens from Arizona, California, Washington Territory, Wyoming, and California under ***clausa***, although he based his description chiefly on specimens from Massachusetts and Connecticut. The western specimens are now known as ***rubida***, ***seminuda***, and ***aperta***, and the last two may easily belong with ***clausa***. But, as at present restricted, ***clausa*** is confined to the east. The M. C. Z. has it ranging from Maine to North Carolina, and the A. M. N. H. has it also from Sioux City, Iowa. One of the North Carolina specimens has the radial-five cell (first posterior) very narrowly open. Röder (1889) places ***castanea*** Bigot as a synonym of ***clausa***, but he apparently follows Williston and does not recognize the forms here called ***seminuda*** and ***rubida***.

Myopa aperta Röder

Myopa clausa var. *aperta* Roder, 1889, Wien, Ent. Zeit. 8: 5.

Types: from Nevada and British Columbia in the Zool. Museum at Halle.

The M. C. Z. has *aperta* from Washington, Utah, and Colorado. Others have been seen from Oregon (Or. State Coll.), California and Wyoming (A. M. N. H.).

Genus **Zodion** Latreille

Zodion Latreille, 1796, Précis des Caract. Gén. p. 162, no species mentioned; 1802, Hist. Nat. Crust. et Ins. 3: 444.

Genotype: *Myopa cinerea* Fabricius, monobasic.

Of all our genera *Zodion* is the most difficult in the determination of species. Recently Sidney Camras, in three papers (Ent. News, 54: 187–191, 1943; Pan-Pacific Ent., 20: 121–128, 1944; and 21: 31, 1945) has ably brought workable order into the genus and on pp. 127–128 presents a key to species. This writer, just before the war, had similarly revised the genus and had proposed in manuscript many of the changes made by Camras. The only major difference is that this writer places the last four species, recognized by Camras, in *Robertsonomyia* Malloch, a genus not mentioned by Camras but which includes as its genotype the first of these four species. In agreement with Camras (1945), *Zodion bimaculata* Curran is transferred to *Occemyia*.

Zodion pictulum Williston

Zodion pictulum Williston, 1885, Trans. Conn. Acad. Arts & Sci. 6: 379–80.

Type: holotype from New Mexico in the Snow Entomological Collections at Lawrence, Kansas.

Camras, p. 187, merely places *pictulum* in a separate group, p. 187, and in the key, p. 127, without giving data. The only specimen seen is one from 6800 ft., Williams, Arizona, Aug. 8, 1934, in the A. M. N. H.

Zodion cyanescens Camras

Zodion cyanescens Camras, 1943, Ent. News, 54: 188–190.

Types: holotype and allotype from Smokemont, North Carolina, in Chicago Mus. Nat. Hist.; two paratypes No. 26684 from Monticello, Fla., and Raleigh, N. C., in M. C. Z.; paratypes in various collections.

This species, the southeastern representative of *obliquefasciatum*, occurs from New Jersey to Florida and Mississippi.

Zodion obliquefasciatum (Macquart)

Myopa obliquefasciatum Macquart, 1845, Dipt. Exot., Suppl. I, p. 141.
Zodion splendens Jaennicke, 1867, Neue Exot. Dipt. p. 97–98, Pl. 2, fig. 12.
Zodion leucostoma Williston, 1885, Trans. Conn. Acad. Arts & Sci. 6: 380.

Types: of *obliquefasciatum* from Galveston, Texas, in the Mus. Hist. Nat. at Lille; of *splendens* from Mexico possibly in the Berlin Museum; of *leucostoma* one cotype each from western Kansas, Arizona, and Montana in the Snow Entomological Collections at Lawrence, Kansas two autotypes, possibly cotypes, in the M. C. Z.

Since Williston placed Macquart's name as an unrecognized species of *Myopa*, he redescribed the pollinose phase. Camras (Ent. News. 54: 190) recognizes three phases: melanistic, rufous, and pollinose, and gives the distribution of the three phases. The species occurs all over

the west, east to Illinois and Louisiana, south into Mexico. Additional states not mentioned by Camras but represented in the M. C. Z. are Montana, Washington, and Oregon. An example from Jicara, Guatemala (A. M. N. H.) is aberrant and perhaps closer to ***albonotatum***. Townsend (1895) records it from Zacatecas, Mexico.

Zodion albonotatum Townsend

Zodion albonotatum Townsend, 1897, Journ. N. Y. Ent. Soc. 5: 175.

Type: from Brownsville, Texas, cannot be found in the British Museum, U. S. N. M., or Snow Entomological Collections.

This writer had placed this name as a synonym of ***obliquefasciatum***, but Camras (Ent. News, 54: 191) recognizes it as a distinct species on the basis of a male, melanistic phase, from Tucson, Arizona, and two males, pollinose phase, from 6400 ft., Jim Creek, Boulder, Colorado.

Zodion fulvifrons Say

Zodion fulvifrons Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 83–84.
Zodion abdominale Say, 1823, loc. cit. 3: 84.
Myopa rubrifrons Robineau-Desvoidy, 1830, Essai sur les Myodaires in Mem. Sav. etr. Acad. Sci., Paris, 2: 247.
Zodion flavipenne Bigot, 1887, Ann. Soc. Ent. France (6) 7: 204.
Zodion lativentre Graenicher, 1910, Canad. Ent. 42: 26.
Zodion sayi Banks, 1916, Ann. Ent. Soc. Amer. 9: 194.
Zodion obscurum Banks, 1916, loc. cit. 9: 194–5.
Zodion reclusum Banks, 1916, loc. cit. p. 195.
? *Zodion bilineata* Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 586–7.

Types: of ***fulvifrons*** from Md. and Penn. is lost; of ***abdominale*** from Neb. is lost; of ***rubrifrons*** from Penn. in Paris Museum; of ***flavipenne*** from Mex. in coll. of J. E. Collin, England; of ***lativentre*** from Wis. in Milwaukee Public Mus.; of ***sayi*** holotype No. 13541 from Falls Church, Virginia, and 3 paratypes: 1 same data, 1 Horse Lake, Or., 1 Mt. Jefferson, Or., in the M. C. Z.; of ***obscurum*** holotype No. 13543 from Bear Valley, San Bernadino Mts., Calif., in the M. C. Z.; of ***reclusum*** holotype No. 13543 from Redlands, Calif., in the M. C. Z.; paratypes at Oregon State College; of ***bilineata*** from Oregon in the Calif. Acad. Sci.

The above synonymy is that of Camras (1944) who has taken the bull by the horns and synonymized more names than this writer inclines to do. Camras also discusses the variations responsible for the different names. Specimens have been seen ranging from Nova Scotia and Ontario west to Washington and California and south into Florida and Mexico.

Zodion intermedium Banks

Zodion intermedium Banks, 1916, Ann. Ent. Soc. Amer. 9: 193–4.
Zodion occidentale Banks, 1916, loc. cit. p. 194.
Zodion basalis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 586.

Types: of ***intermedium*** holotype No. 13540 from Pocono Lake, Penn., in M. C. Z., 2 paratypes: one with same data and one from Clementon, New Jersey, in M. C. Z., paratypes in U. S. N. M.; of ***occidentale*** holotype No. 13542 from Montaville, Oregon, one paratype from Corvallis, Oregon, in M. C. Z., paratypes same data and from Mary's River, Oregon, in Or. State College; of ***basalis*** from Moscow Mts., Idaho, in Calif. Acad. Sci.

This writer had considered ***occidentale*** a distinct species but is following Camras who found intermediates connecting it with ***intermedium***. The M. C. Z. has this ranging from Quebec and Ontario to New Jersey and Penn., west to Texas, Calif., Or., and Wash.

Zodion perlongum Coquillett

Zodion perlongum Coq., 1902, Can. Ent. 34: 199.

Types: from Colorado, New Mexico, and Mexico (Sierra Madre) in the U. S. N. M. (No. 6297).

The M. C. Z. has this ranging from Vermont through Nebraska and Colorado to southern California. It has also been seen from Me., N. H., N. J., Wis., N. M., and Ariz.

Zodion abitus Adams

Zodion abitus Adams, 1903, Sci. Bull., Univ. of Kansas, 2: 33–34.
Zodion bicolor Adams, 1903, loc. cit. p. 35.

Types: of ***abitus*** one cotype from Douglas Co., Kansas, and one from Mass.; of ***bicolor*** two cotypes from Douglas Co., Kansas, all in the Snow Entomological Collections at Lawrence, Kansas.

Independently this writer and Camras decided that ***abitus*** is the female and ***bicolor*** the male of the same species. The present writer had used the name ***abdominale*** for this species, but Camras has explained under ***fulvifrons*** (p. 122) why he placed ***abdominale*** as a synonym of the latter. The M. C. Z. has ***abitus*** from Ontario to Virginia, west to Ohio and Kansas. Others have been seen from Quebec (A. M. N. H.) and Colorado (Coll. Agr. Coll.). Krōber (1939) records a female from Nova Teutonia, Brazil.

Zodion angusticornis Van Duzee

Zodion angusticornis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 589.

Type: holotype from Los Banos, California in Calif. Acad. Sci.

Based on a unique female, ***angusticornis*** has not been recognized by Camras or this writer.

Zodion cinereiventre Van Duzee

Zodion cinereiventris Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 585.

Types: holotype and allotype from Huntington Lake in Fresno Co., paratypes from Pleyto in Monterey Co. and San Diego, California; also Preston, Idaho.

Camras (1944, p. 124) admits that certain examples of ***cinereiventre*** blend into ***abitus*** and ***triste***, and discusses the relationship. This writer would place ***cinereiventre*** as a synonym of ***triste***. The distribution, after Camras, is western states east definitely to Illinois.

Zodion triste Bigot

Zodion triste Bigot, 1887, Ann. Soc. Ent. France, 7: 203–4.

Type: from California in collection of J. E. Collin.

As Camras states, ***triste*** may be indistinguishable from ***cinereiventre***. He places under ***triste*** only three examples from San Diego, California.

Zodion nigrifrons Kröber

Zodion nigrifrons Kröber, 1915, Arch. fur Naturgesch. (1915) Abt. A. H. 4, p. 97.
Zodion hirtipes Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 587–8.

Types: of ***nigrifrons*** from California in Mus. Civ. Stor. Nat. at Milan (Bezzi coll.); of ***hirtipes*** holotype from Melrose, Alameda Co., Calif., and allotype from Klamath Lake, Oregon, in the Calif. Acad. Sci.

Since Van Duzee merely copied Kröber's key and evidently did not read the description, he redescribed ***nigrifrons***. A very dark example from San Jose, Calif., is in the M. C. Z. Camras has seen it from Berkeley, and Fish Ranch, Berkeley Hills.

Zodion americanum Wiedemann

Zodion americana Wiedemann, 1830, Auss. Zw. Insecten 2: 242.
Zodion nanellum Loew, 1886, Centuriae VII, No. 75, p. 102.
Zodion pygmaeum Williston, 1885, Trans. Conn. Acad. Arts & Sci. 6: 381.
? *Zodion occidensis* Walker, 1849, List. Dipt. Brit. Mus., 3: 676.

Types: of ***americanum*** from Montevideo, Uruguay, in the Vienna Mus. (Wiedemann coll.); of ***nanellum*** holotype No. 438 from Washington, D. C., in the M. C. Z.; of ***pygmaeum*** one labelled "Type Wilstn. Calif. Baron 437" in M. C. Z., also 3 coypes from Calif. and one from Colo. in Snow Entomological Collections at Lawrence, Kansas; of ***occidensis*** from Ohio in the British Museum.

Kröber (1915) states that a female (without head) next to the male type of ***americanum*** in the Wiedemann collection is identical with ***nanellum***. Williston (1885) did not have ***nanellum*** before him when he described western specimens as ***pygmaeum***. Types of both in the M. C. Z. are identical and do not show the differences stated by Van Duzee (1927) and by Kröber (1939). The M. C. Z. has ***americanum*** ranging from Quebec and Maine to Louisiana west to California (Redlands, Pasadena). Specimens from Trinidad (Dabadie), Brazil (Chapada), and Guatemala (Moca Guatalon) have been seen in the A. M. N. H. Kröber (1939) records it from Mexico, Porto Rico, Venezuela, Columbia, Brazil, Uruguay, Paraguay.

Zodion albifacies Van Duzee

Zodion albifacies Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 588.

Type: from Baboquivari Mts., Arizona, in the Calif. Acad. Sci.

Based on a unique female, ***albifacies*** has not been recognized by Camras or this writer.

Genus **Robertsonomyia** Malloch

Robertsonomyia, 1919, Proc. Ent. Soc. Wash. 21: 205.

Genotype: ***Zodion palpalis*** Robertson, monobasic.

This genus was not mentioned by Van Duzee (1927), Curran (1937), or Camras (1944) probably because the genotype has been identified in collections as ***Zodion scapularis*** instead of ***palpalis***. ***Robertsonomyia***, as defined in the key, is certainly valid and is intermediate between ***Zodion*** and ***Occemyia***. ***Occemyia*** also has the thorns on the femora and the long labella but has the first posterior cell (R5) open and the proboscis geniculate. The species are discussed by Camras (1944) under ***Zodion***.

Robertsonomyia palpalis (Robertson)

Zodion palpalis Robertson, 1901, Can. Ent. 33: 284.
Sicus brevirostris Coquillett, 1902, Can. Ent. 34: 198.
Zodion scapularis Adams, 1903, Sci. Bull., Univ. of Kansas, 2: 34.

Types: of ***palpalis*** from Carlinville, Illinois, in the collection of the Illinois Natural History Survey at Urbana, 1 paratype in collection of J. R. Malloch, 1 paratype No. 25888 in M. C. Z.; of ***brevirostris*** 1 holotype and 1 paratype from 7300 ft., Sierra Madre, Chihuahua, Mexico, in the U. S. N. M.; of ***scapularis*** a single type from Arizona in the Snow Entomological Collections at Lawrence, Kansas.

Suspecting that ***brevirostris*** was a synonym of ***palpalis***, a copy of the key to genera was sent to Washington. Mr. C. T. Greene kindly wrote (in litt. Aug. 4, 1942), "I checked Coquillett's type of ***brevirostris***. It runs out in this key to ***Robertsonomyia*** Malloch. In the left wing of the type the first posterior cell is ***just closed*** while the right wing has a ***long petiole***. The paratype specimen has both wings like the right [wing]." Camras (1945, p. 31) writes that he examined the type of ***brevirostris*** and that "it does not seem to differ from (***Zodion***) ***palpale***." He also states (1944, p. 126) that the first posterior cell (R5) may be narrowly open. Adams' ***scapularis*** is maintained as a distinct species by Camras although he had not seen specimens and suspects that an individual variation is involved. The shining inner halves of the humeri, as mentioned by Adams, is not a specific character but due to movement of the head. Mr. Greene wrote that it is not represented, as ***palpalis*** or ***scapularis***, in the U. S. N. M. The M. C. Z. has it from Georgia, Illinois, Nebraska, and Colorado. Camras records it from Raleigh, North Carolina.

Robertsonomyia parva (Adams)

Zodion parvis Adams, 1903, Sci. Bull. Univ. of Kansas, 2: 34–35.

Type: two cotypes from Arizona in the Snow Entomological Collections at Lawrence, Kansas.

The limits of ***parva*** are highly questionable. This writer had included ***lovetti*** as a synonym but then admitted that the resulting species is highly variable. Such a species is represented in the M. C. Z. by a small series from Virginia and Nebraska. Camras (1944, pp. 126–7) briefly defines ***parva*** and ***lovetti***, placing the latter as a separate species. He had seen only one example of his version of ***parva*** from Colorado.

Robertsonomyia lovetti (Van Duzee)

Zodion lovetti Van Duzee, 1934, Ann. Ent. Soc. Amer., 27: 323.

Type: from Fort Collins, Colorado, in Calif. Acad. Sci.

Camras (1944, p. 127) defines ***lovetti*** and records a unique from Tennessee Pass, Colorado.

Genus **Occemyia** Robineau-Desvoidy

1853, Dipt. des Environs de Paris, Myopaires, p. 50.

Genotype: ***Myopa atra*** Fabricius, the second of two species, by designation of Coquillett, 1910, Proc. U. S. Nat. Mus. 37: 605.

Synonyms: *Thecophora* Rondani, 1845 *nec* Charpentier, 1840 (also not *Thecophora* Rondani, 1857, of authors); *Melanosoma* Rob.-Desv. 1853; *Oncomyia* Loew; 1866 (emend. of *Occemyia*); *Eccemyia* Graen. 1910, Bull. Wiscons. Soc. Vol. 8, pt. 1, p. 44; *Thecomyia* Brues and Melander, 1932, Bull. M. C. Z., 73:306 (*lapsus calami teste* Melander *in litt.*).

For discussion of the generic name and synonyms see Parsons (1940, Psyche, 47:35). Camras (1945, Ann. Ent. Soc. Amer. 38:216–222) has ably brought workable order to the confusion of names. Nevertheless, as Camras indicates, there are still many points in question. Although this writer's manuscript arrangement of this difficult genus varies from that of Camras, the latter is followed entirely. He also gives a key to species, p. 222. The distribution here given is that of Camras.

Occemyia propinqua Adams

Oncomyia propinqua Adams, 1903, Sci. Bull., Univ. of Kansas, 2: 32.
Oncomyia angusticornis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 595.
Oncomyia longipalpis Van Duzee, 1934, Ann. Ent. Soc. Amer. 27: 321.

Types: of *propinqua* from unknown locality presumably in the Snow Entomological Collections at Lawrence, Kansas; of *angusticornis* holotype and allotype from Moscow Mt., Idaho, paratypes from Wash., Ore., Calif., and Ariz., in Calif. Acad. Sci.; of *longipalpis* holotype from Spanway, Washington, paratype Corvallis, Wash., in Calif. Acad. Sci.

Southern Canada and the United States.

Occemyia nigripes Camras

Occemyia nigripes Camras, 1945, Ann. Ent. Soc. Amer. 38: 218–9.

Types: holotype and allotype from Thunder Bay Beach, Ontario, in Chicago Natural History Museum, 11 paratypes from Vt., N. Y., N. C., Ore., and Wash., in the M. C. Z., many paratypes from Quebec, Ontario, Manitoba, all parts of the United States and one from Helvetia, San Sebastian, Guatemala, in other collections.

Occemyia nigra Van Duzee

Oncomyia nigra Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 596.

Type: from Corvallis, Oregon, in Calif. Acad. Sci.,
Maine, Oregon, California.

Occemyia loraria Loew

Oncomyia loraria Loew, 1866, Centuriae VII, No. 74, pp. 101–2.
Oncomyia baroni Williston, 1883, Trans. Conn. Acad. Arts and Sci. 6: 97–98.
Oncomyia brevirostris Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 593.
Oncomyia aequalis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 594.
Oncomyia terminalis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 594.
Zodion bimaculata Curran, 1933, Amer. Mus. Novitates, 673: 7.
Oncomyia frontalis Van Duzee, 1934, Ann. Ent. Soc. Amer. 27: 322.

Types: of *loraria* pair on pin with name label and two other pinned specimens all from New Hampshire with type label "446" in M. C. Z.; of *baroni* specimen labelled "Calif. Baron Type Wlstn. 443" in M. C. Z., 4 cotypes from Calif. in Snow Entomological Collections at Lawrence,

Kans.; of ***brevirostris*** holotype from Pullman, Wash., paratype from Mt. St. Helena, Calif.; of ***aequalis*** holotype from Lake Co. paratype from Marin Co., Calif.; of ***terminalis*** holotype from Hood River, Oregon, paratypes from Wash.; of ***bimaculata*** from Timagami, Ontario, in A. M. N. H.; of ***frontalis*** from Puyallup, Wash., all of Van Duzee's types in Calif. Acad. Sci.

Southern Canada and the United States.

Occemyia longicornis Say

Myopa longicornis Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 83.
Oncomyia infuscipes Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 592.

Types: of ***longicornis*** from "Missouri" is lost; of ***infuscipes*** holotype from Kearney, Ontario, allotype and paratype from Irving, Erie Co., N. Y., in the Calif. Acad. Sci.

Southeastern Canada and eastern United States west to Colorado, New Mexico and Arizona.

Occemyia modesta Williston

Oncomyia modesta Williston, 1883, Trans. Conn. Acad. Arts and Sci. 6: 96.

Types: one specimen labelled "Calif. Baron Type Wlstn 445" in M. C. Z., 3 cotypes from Washington Territory in the Snow Entomological Collections at Lawrence, Kans.

Southwestern Canada and western United States, east to Saskatchewan, Colorado, and New Mexico.

Occemyia luteipes Camras

Occemyia luteipes Camras, 1945, Ann. Ent. Soc. Amer. 38: 220–1.

Types: holotype and allotype from Pullman, Washington, in Calif. Acad. Sci., one paratype No. 26685 from Tooele, Utah, in the M. C. Z.; other paratypes from Calif., Wash., Idaho, Utah, and Col., in various collections.

Occemyia abbreviata Loew

Oncomyia abbreviata Loew, 1866, Centuriae VII, no. 73, pp. 101.
Oncomyia modesta var. *melanopoda* Williston, 1885, Trans. Conn. Acad. Arts and Sci. 6: 96, 393.

Types: of ***abbreviata*** Loew 2 cotypes No. 444 from Washington, D. C., in M. C. Z.; of ***melanopoda*** a cotype from Jefferson, N. H., and a cotype from White Mts., N. H., in the Snow Entomological Collections at Lawrence, Kans.

Southeastern Canada and eastern United States west to South Dakota.

Genus **Sicus** Scopoli

Scopoli, 1763, Ent. Carm., p. 369.

Genotype: ***Conops ferruginea*** Linn., the first of two species, by designation of Coquillett, 1910. Proc. U. S. Nat. Mus. 37: 605.

Synonym: *Cylindrogaster* Lioy, 1864.

Sicus has been included in the New World fauna but is here excluded and is confined to the Palaeartic region. Of the two recorded New World *Sicus*, *brevirostris* Coq. is discussed under *Robertsonomyia palpalis* (Robertson) of which it is a synonym, and *ciliatus* Van Duzee (1927, Proc. Calif. Acad. Sci. 16: 599–600. St. Paul Island, Alaska) belongs in the family Scatophagidae according to Camras (in litt.) who examined the unique male type in the Calif. Acad. Sci.

Genus **Stylogaster** Macquart

Macquart, 1835, Hist. Nat. des Insectes. Dipteres, 2: 38, pl. 13, fig. 15.

Genotype: *Conops stylata* Fabr. monobasic.

Synonyms: *Stylomyia* Westwood. 1850; *Ptychoproctus* Bigot, 1859.

The New World members of this genus have been revised by Aldrich, 1930, Proc. U. S. Nat. Mus., Vol. 78, Art. 9, pp. 1–27.

Ocellar triangle opaque, long, almost or quite reaching the lunule, third antennal segment three or four times the length of second.....**neglecta** Will
Ocellar triangle shining, much shorter, rarely extending a little beyond middle of front, second and third antennal segment about equal in length, **biannulata** (Say)

Stylogaster neglecta Williston

Stylogaster neglecta Will., 1883, Trans. Conn. Acad. Arts and Sci. 6: 91–92, pl. 61, fig. 8.

Type: one specimen from Connecticut labelled "Type Wlstn 450" in M. C. Z. and one cotype each from Connecticut and Pennsylvania in the Snow Entomological Collections at Lawrence, Kans.

The M. C. Z. has a series taken on flowers of *Cephalanthus*, *Eupatorium purpureum*, and *Clethra alvifolia*, ranging from Massachusetts to Virginia, also Pinaleno Mts., Arizona. Aldrich recorded it also from Indiana and Onaga, Kansas.

Stylogaster biannulata (Say)

Myopa biannulata Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 81.
Myopa stylata Wied., 1830, Auss. Zweifl. Ins. 2: 243. Röder, 1892, Wien. Ent. Zeit. 11: 287.
Stylogaster stylata Macq., 1843, Dipt. Exot. 2: 18, in error.
Stylomyia confusa Westwood, 1850, Proc. Zool. Soc. Lond. 18: 269–270, pl. 19, fig. 4.

Types: of *biannulata* from Pennsylvania is lost; of *stylata* Wied. from Pennsylvania (probably a cotype), and Brazil (another species) in the Vienna Museum; of *confusa* from an unknown locality in the British Museum.

The M. C. Z. has *biannulata*, taken on *Helianthus strumosus*, from New Jersey, Delaware, Florida, and Mississippi. Specimens have also been examined from Kingston, Rhode Island (New England Mus. Nat. Hist.), South Meriden, Conn. (Conn. Agr. Exp. Sta.), and Chichenitza, Yucatan, Mex. (A. M. N. H.). Aldrich recorded it also from Indiana and Texas.

NOTES ON THE PHLEBOTOMUS OF PANAMA

(Diptera, Psychodidae)

III. P. CRUCIATUS COQ., TRINIDADENSIS NEWST. AND GOMEZI NITZ.[1]

G. B. FAIRCHILD[2] AND MARSHALL HERTIG[3]

The three species treated in the present paper are considered together because two of them, *cruciatus* and *trinidadensis*, have been confused with each other for many years, while *cruciatus* and *gomezi* are closely related man-biting species likely to be confused with one another. *P. cruciatus* does not occur in Panama, but is included for comparison with *gomezi* and to clarify its status.

Phlebotomus cruciatus Coquillet

1907, Ent. News, *18*, p. 102 (♀; Cacao, Trece Aguas, Alta Vera Paz, Guatemala). Haseman, 1907, Trans. Amer. Ent. Soc. *33*, p. 322. Summers, 1913, J. London Sch. Trop. Med., *2*, p. 115. Shannon, 1913, Proc. Ent. Soc. Washington, *15*, p. 166. Larrousse, 1921, Etud. Syst. Med. Phleb., pp. 64, 74. Shannon, 1926, Journ. Wash. Acad. Sci., *16*, p. 193, fig. 5 (♀ cerci). Not *Phlebotomus cruciatus* Dyar (1929) and others. (The extensive references to the name listed by Barretto (1947), other than those here cited, are to *trinidadensis* Newst. in whole or in part, following Dyar.)

This species has been long misunderstood. Only Shannon and Dyar, aside from the original describer, had access to material, and the latter by associating males of another species completely submerged the true identity of *cruciatus*.

We have recently had the opportunity of examining the type material of this species at the U. S. National Museum. The Types consisted of five females from Cacao, Trece Aguas, Alta Vera Paz, Guatemala, collected April 2, 15, 18 and 26, 1906, by Messrs. H. S. Barber and E. A. Schwarz. Of these, two specimens appear to have been mounted, but only one of these shows the structure of spermathecae and cibarium. We have measured both specimens and made camera lucida drawings of the cibarium, pharynx and spermathecae of the one which shows these structures (Slide No. 5051, labeled as Paratype).

The original description of this species is wholly inadequate, and has led others to regard the name as a *nomen nudum*. The description reads as follows: "Same as *vexator*, except that the hairs are chiefly yellow and the first submarginal cell is about three times as long as its petiole. Male unknown."

Mr. H. S. Barber, one of the collectors, records the species as a severe biter (Proc. Ent. Soc. Washington, *8* (3–4), p. 102, 1906 (1907),

[1]This work was initiated under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the Gorgas Memorial Laboratory. Cost of publication is paid by the Gorgas Memorial Institute.

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[3]Major, Sanitary Corps, A. U. S.

and one of us in conversation with Mr. Barber on 16 Jan., 1946, elicited the information that he and Mr. Schwarz took the type specimens on several occasions, once biting in the jungle in the daytime, and at other times resting on the outside walls of a house at night where they were collecting other insects attracted to a lantern inside the screen door of the house.

On page 107 of the same number of the Proc. Ent. Soc. Washington there is a photograph of the type locality, which is stated to be at an elevation of about 900 ft. and in heavy rain forest.

We have recently received a number of specimens of *Phlebotomus* from various localities in Mexico through the courtesy of Dr. Luis Vargas. This material consists of 3 females from Tapachula, 2 females

TABLE I

MEASUREMENTS IN MICRA

	P. gomezi, Panama.						*P. cruciatus*, Mexico and Guatemala.				
	Maximum		Minimum		Mean		Maximum	Minimum	Mean	Types	
	♂	♀	♂	♀	♂	♀	♀	♀	♀	♀	♀
Ant. III	332	300	300	240	314	273	308	264	286	273	318
Palpi I + II	224	216	172	184	196	202	220	176	203	184	215
Palpi III	208	200	172	176	187	187	192	168	178	174	175
Palpi IV	148	140	120	116	133	130	148	128	136	105	140
Palpi V	424	440	240	240	358	352	456	240	358	347	300
Head height	280	288	256	260	268	276	280	248	265	397	433
Clypeus	140	148	116	132	126	139	132	120	126	.....	.....
Proboscis	284	348	240	296	264	327	312	248	287	290	314
Eye height	240	236	208	208	224	219	232	200	214	.....	.....
Wing length	2120	2080	1800	1850	1960	1970	2080	1830	1940	1790	2000
Alpha	612	648	504	504	550	568	558	396	502	447	546
Beta	288	278	216	180	237	234	306	216	259	249	278
Gamma	288	324	216	216	244	270	342	252	293	264	315
Delta	216	234	126	108	165	176	162	72	102	84	104

from Arroyo Expangale, Tabasco, 7 females from Finca El Vergel, Chiapas, 1 female from Tamazunchale, San Luis Potosi and 1 female from Guadelupe, Zaju, Chiapas. Other material sent us at the same time from Tapachula, Chiapas, and Matamoros, Campeche, was already mounted, but not well enough to make out the necessary details of structure, although we suspect they are the same species. The first fourteen specimens, mounted by us, agree very closely in the structure of the spermathecae with *cruciatus*, and we are inclined to believe they represent that species. Measurements of wing and palpi and structure of the cibarium also agree. Finally, one of us collected a single female from buttresses of a hollow tree in heavy forest in the lowlands of Guatemala near Esquintla which agrees closely with the Types and the Mexican material. We have seen then, at least fifteen females of what we believe to be true *cruciatus*.

On comparing this material and our drawings and notes on the Types with specimens of *P. gomezi* Nitz. 1931 (= *P. suis* Rozeboom, 1940) from Panama, we find no essential differences in measurements of palpi and wings. Although *delta* and *alpha* appear to average somewhat shorter in *cruciatus* than in *gomezi*, the measurements of individual specimens overlap, as shown in Table I. The spermathecae of *cruciatus* (Pl. I, figs. 5, 6) are of the same type as those of *gomezi* (Pl. I, figs. 2, 3) but the ducts are considerably shorter and thicker in *cruciatus*, and there is less contrast in the diameter of heads and ducts than in *gomezi*. The cibaria also appear to differ consistently. In *cruciatus* (Pl. I, fig. 4) the chitinous arch is well marked, complete, rather flat and quite distant from the teeth, while in *gomezi* it tends to be incomplete or very faint in the middle, more arched, and considerably closer to the teeth in Panama specimens. Barretto (1946) shows a complete but pointed arch for a specimen from Venezuela.

A further difference is to be seen in the structure of the cerci and the ninth tergite. In *cruciatus* the cerci (Pl. II, fig. 6) are very long and slender and bear three long stout hairs on the ventral side near the base. In *gomezi* the cerci (Pl. II, fig. 7) are shorter and more angled, but bear the same stout hairs. The ninth tergite of *cruciatus* (Pl. II, fig. 5) shows a curious papillate and heavily sclerotized area on the lateral anterior margin of the segment, entirely lacking in *gomezi*. Its degree of development varies in our material, but it is always present.

It is our opinion that these two forms may eventually prove to be races of a single species, but since we have no material from the extensive intermediate area, and the forms are distinguishable, it seems best to retain them as separate species for the present.

In regard to possible males of *cruciatus*, we have four males taken in company with the above mentioned female from near Esquintla, Guatemala. They are not distinguishable with certainty from males of *gomezi* from Panama, though our material is not in the best condition. The parameres appear somewhat more slender and the genital filaments slightly heavier than in Panama males, but the differences may be due to accidents of mounting. The figure of the paramere of *gomezi* given by Barretto (1946) differs to about the same degree from the appearance of Panama material as do the Guatemala males, but in an opposite direction, the Panama specimens showing an approximately intermediate condition.

The fact that the Types of *cruciatus*, and some of our Mexican material also, were taken biting man, is a further suggestive bit of evidence, as *gomezi* is one of the two species commonly taken biting man and other large animals in Panama. The Type of *gomezi* was taken in a lighted room in Venezuela, but we can find no published statement that it is a man-biting species in Venezuela, French Guiana or Brazil.

In regard to the identity of *suis* and *gomezi*, we accept provisionally their synonymy, although it may be well to point out certain discrepancies in the description of Venezuelan and Panamanian material. In his figure of the female cibarium, Barretto (1946, fig. 9) shows a high and rather pointed chitinous arch, while Panama material as figured by Rozeboom (1940) shows the arch evenly rounded and faintly or not at

all visible centrally. We find both conditions and intergrades in our material, heavily stained specimens showing the arch practically continuous. A further character of possible importance in the cibarium of Panamanian *gomezi* is the prominently pigmented floor of the cibarium. This pigmentation begins abruptly just distal to the chitinous arch and fills out the distal two-thirds of the cibarium. We have noted this character in other species though it seems to have been overlooked by previous workers. It is best seen in unstained mounts, heavy staining obscuring the condition. Nitzulescu's (1931) figure of *gomezi* also shows a high and rather pointed arch. Barretto's figure shows two small lateral supplementary horizontal teeth in the cibarium, also shown by Nitzulescu, but not shown by Rozeboom nor seen by us, though we have seen material with a single supplementary tooth. In regard to Barretto's figure of the male, he shows a more clubbed paramere than any we have seen from Panama, the genital filaments in his specimen were apparently considerably more slender than in ours, and his basal tuft does not show the raspberry-like cluster of individual hair bases and the rather spreading habit of the tuft which seem quite characteristic of Panama material.

It might be well to point out also that *P. diabolicus* Hall from Texas appears to be quite closely related to *cruciatus* and *gomezi*. The male genitalia are very similar indeed to those of *gomezi*, and without material for comparison we are unable to point out valid differences. The differences indicated by Rozeboom (1940) in his description of *suis* apparently do not hold, as Hall's figure (1936) of *diabolicus* seems to have been misleading. Addis (1945) redescribed and figured *diabolicus* from topotypical material compared with the Types, and his figure of the genitalia shows no differences of importance from *gomezi*. The female of *diabolicus* described and figured by Addis differs from both *cruciatus* and *gomezi* in having six spines in the cibarium. It further differs from *cruciatus* in apparently lacking the papillate area on the ninth tergite and in more slender spermathecal ducts. However, the figure of the head of the spermatheca given by Addis is not entirely convincing, and may have been drawn from a shrunken specimen. The annulations are not clearly distinguished. From *gomezi* the female seems to differ further in having a well-marked chitinous arch and shorter spermathecal ducts. Measurements of wings, palpi, etc., show no significant differences between the three species, though *diabolicus* shows slightly shorter palpi and a slightly longer *gamma* than do the other two.

Both *gomezi* and *cruciatus* may occasionally show one or two small supernumerary teeth at the side, in the cibarium, and it is possible that *diabolicus* may eventually prove to be but a well-marked subspecies of

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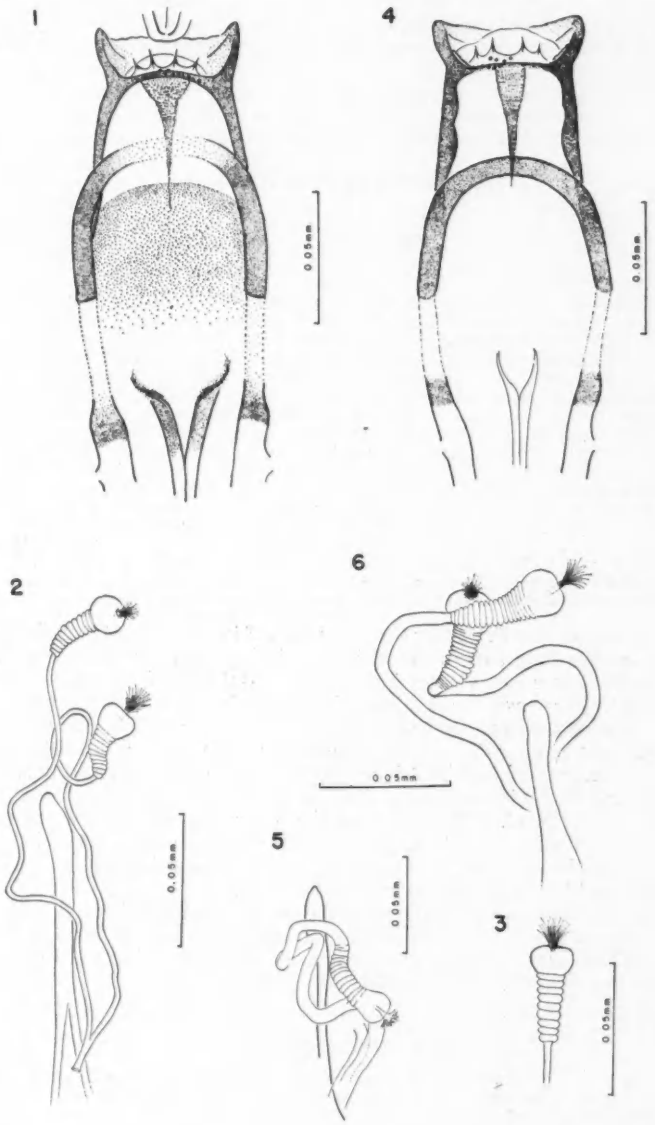
EXPLANATION OF PLATE I

Fig. 1. Cibarium of *P. gomezi* ♀ from Panama (Slide 833). Fig. 2. Spermathecae of *P. gomezi* from Panama, drawn in phenol. Fig. 3. Spermathecal head of *P. gomezi* from Panama showing maximum expansion, drawn in phenol. Fig. 4. Cibarium of *P. cruciatus* from Tapachula, Mexico (Slide 828). Fig. 5. Spermathecae of *P. cruciatus*, camera lucida drawing from a paratype, U. S. N. M. 5051. Fig. 6. Spermathecae of *P. cruciatus* from Tapachula, Mexico, drawn in phenol (Slide 827).


1
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cruciatus, a statement which also holds for *gomezi*. The fact that *diabolicus* is also a man-biting species is especially suggestive. As things stand now, it would be impossible to separate from one another males of *gomezi* and *diabolicus*, or the presumptive *cruciatus* males which we have studied. The differences rest entirely on the females, so that if the advice of Mangabeira and Galindo (1944, p. 192) were to be literally followed it would be necessary to consider these forms as a single species.

Phlebotomus gomezi Nitzulescu

1931, Ann. Parasit. Hum. Comp., *9*, pp. 247–255, figs. 1–6; Pl. IV (♀; San Cristobal, Venezuela). Costa Lima, 1932, Mem. Inst. Osw. Cruz, *26*, pp. 67–68, figs. 83, 138 (♀; Venezuela). Bequaert, 1938, Carnegie Inst. Washington, Pub. No. 499, pp. 230, 233. Pinto, 1938, Zooparasit. Inter. Med. Vet., p. 152. Ortiz, 1942, Bol. Lab. Clin. Luis Razetti, *3*, p. 167. Floch and Abonnenc, 1945, Inst. Pasteur Guyane, Pub. No. 100, p. 9. Barretto, 1946, An. Fac. Med. Univ. S. Paulo, *22*, pp. 1–7, figs. 1–11 (=*suis* Rozeb. ♂, ♀; States of S. Paulo and Para, Brasil and Venezuela); 1947, Arq. Zool. Est. S. Paulo, *5*, p. 202. Ortiz, 1947, Bol. Lab. Clin. Luis Razetti, Ano VIII, Vol. XV, p. 520 (=*suis* Rozeb. States of Aragua, Barinas and Tachira, Venezuela).

Phlebotomus suis Rozeboom, 1940, Amer. J. Hygiene, *32*, (1), Sec. C, pp. 8–11, figs. 1–5, (♂, ♀; Las Guacas, Panama). Mangabeira, 1941, Mem. Inst. Osw. Cruz, *36*, p. 376 (♂; Aura, Belem, Para, Brasil). Floch and Abonnec, 1943, Inst. Pasteur Guyane, Pub. No. 62, p. 7. Fairchild, 1943, Amer. J. Trop. Med., *23*, p. 571 (Panama). Iriarte, 1944, Bol. Lab. Clin. Luis Razetti, *5*, p. 269–273 (Venezuela). Floch and Abonnenc, 1945, Inst. Pasteur Guyane, Pub. No. 100, p. 9; 1947, Bol. Ent. Venezolana, *6* (1), p. 13.

Phlebotomus japignyi Floch and Abonnenc, 1944, Inst. Pasteur Guyane, Pub. No. 83, pp. 2–5, fig. 2–3 (♂, ♀; near Cayenne, French Guiana, in cavities in trees); 1945, op. cit., No. 100, p. 9. Barretto, 1947, Arq. Zool. Est. S. Paulo, *5*, (4), p. 206. Floch and Abonnenc, 1947, Bol. Ent. Venezolana, *6*, (1), p. 13.

Phlebotomus trinidadensis Callan, 1947, Rev. Ent. *18*, (1–2), pp. 215–218.

In regard to *P. japignyi*, Floch and Abonnec (1944) distinguish their species from *suis* in the male by relatively slightly shorter genital filaments, fewer and shorter hairs in the basal tuft of the coxite (10 in *japignyi*, 15 in *suis*) and slight differences in the relative lengths of the palpal segments. In the female they distinguish their species from *gomezi* and from *suis*. Their comparison with *gomezi* is made from the drawings published by Nitzulescu, and is based on slight differences in lengths of the spermathecal ducts and pharynx and structure of the spermathecal head. The differentiation from *suis* rests on the presence of 10–12 annulations of the head of the spermatheca, while in *suis* there are said to be but 8. In addition, the annulations are said to be "crenelated" in *japignyi* but rounded in *suis*.

In our material of *suis*, both the length and number of hairs in the tuft on the base of the coxite varies, actual counts ranging from 10 to 17 or more. The palpal measurements, as seen in the table, also vary considerably. Our female *suis* generally shows 9 annulations,

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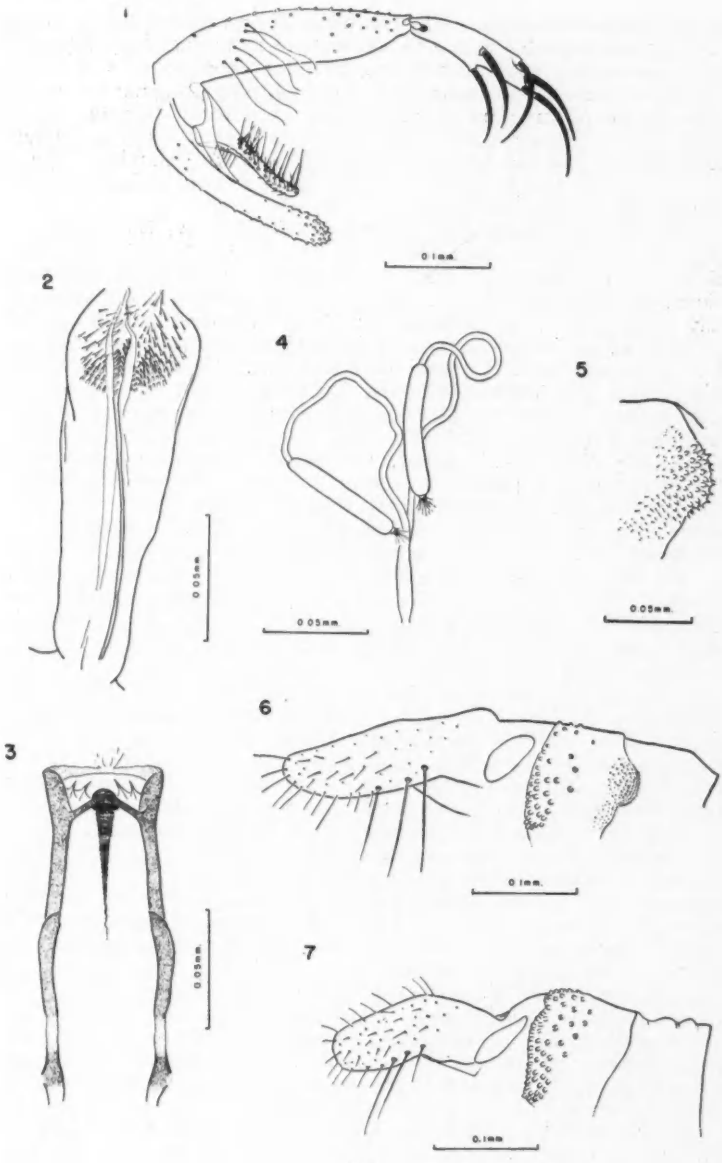
EXPLANATION OF PLATE II

Fig. 1. Inner aspect of male genitalia of *P. trinidadensis* from Panama (Slide 134). Fig. 2. Pharynx of *P. trinidadensis* ♀ from Panama (Slide 880. Fig. 3. Cibarium of *P. trinidadensis* ♀ from Panama. Fig. 4. Spermathecae of *P. trinidadensis* from Panama, drawn in phenol. Fig. 5. Anterior margin of ninth tergite of *P. cruciatus* from Tabasco, Mexico, showing papillate area (Slide 1009). Fig. 6. Cerci and ninth tergite of *P. cruciatus* (Slide 1009). Fig. 7. Cerci and ninth tergite of *P. gomezi* from Panama (Slide 974).


1
0.1mm
2
0.05mm
4
0.05mm
5
0.05mm
3
0.05mm
6
0.1mm
7
0.1mm

but there may be more. The "crenelated" or rounded aspect of the annulations in profile is due to accidents of mounting, fully expanded and unshrunken specimens having rounded annulations, while even slightly shrunken specimens show the annulations angular in profile. Fine details of structure in these organs are difficult to make out at best, and variations in mounting technique lead to quite a different appearance. We can duplicate the appearance of all published figures of *suis*, *gomezi* and *japignyi* in our material, and we believe all three names refer to but one species.

Dr. E. McC. Callan has recently published (Rev. Ent. 18, (1-2), pp. 215–218, 1947) a note on the habits of "*P. trinidadensis*" in Trinidad. Since the species is said there to attack man readily, we were considerably surprised, as we have never found it biting man, or indeed any other animal, in Panama. Dr. Callan was kind enough to send us a vial of specimens taken biting in Trinidad, and these on mounting have proven to be all *P. gomezi*, 11 ♀ and 1 ♂. Dr. Callan states that his material was determined by Dr. O. Theodor, and it is reasonable to assume that the latter felt he was dealing with the same species described and figured by him in 1932 (Bull. Ent. Res., 23, pp. 22–23, figs. 8c, d) as possibly *trinidadensis* Newst. As we will show later, Newstead's female types are at present indeterminate, though they may have been this species, and the name must be based on the male. Theodor's figure differs so much from the appearance of the material sent us by Dr. Callan that we are at a loss to understand his determination.

We have identified some 356 specimens of this species, mostly females. They have been taken in all months of the year, but our data are not complete enough to show seasonal fluctuations in abundance. Specimens have been seen from localities in Darien, Panama, Colon and Los Santos provinces, as well as from several localities in Costa Rica, so that the species probably is widely distributed in the Republic. The majority of our specimens have been secured from horse- or calf-baited mosquito stable traps, but a considerable number have been taken biting man, both outdoors and in houses, even in quite urban areas. Scattered specimens have been taken in a light trap, in crevices in masonry walls, hollow trees, and in the crevices between the buttressed roots of large forest trees. Males are decidedly scarce, most of ours having been taken accompanying females in stable traps or resting on persons accompanying the biting females. One of our associates, Mr. Pedro Galindo, has recently taken the species in some numbers resting on the walls of houses in Calzada Larga, a small village in the Madden Lake area, so it is probable that it is semi-domestic.

This species and *P. panamensis* are the two common man-biting species in Panama, being about equally abundant. We have records of two or three other species biting man or domestic animals, but they are of minor importance in most areas. The bites are sharp and painful, out of all proportion to the size of the insect, and on susceptible persons produce an itching papule which may persist a week or more.

In our experience, sandflies are not often abundant enough in Panama to cause much annoyance; we seldom catch more than a dozen or so per night in stable traps, and two or three per night is the

usual catch, although rarely we have seen as many as 200 taken from a single stable trap.

Phlebotomus trinidadensis Newstead

1922, Ann. Trop. Med. Parasit., *16*, (1), p. 4, fig. 1 (♂, ♀, Trinidad). Galliard, 1934, An. Parasit. Hum. Comp., *12*, (1), pp. 6–7. Mangabeira, 1942, Mem. Inst. Osw. Cruz, *37*, (2), pp. 200–201. Floch and Abonnenc, 1947, Bol. Ent. Venezolana, *6*, (1), p. 24.

Phlebotomus yucatanensis Galliard, 1934, An. Parasit. Hum. Comp., *12*, (1), pp. 1–7, figs. 1–3. (♂, ♀; Chichen Itza, Yucatan, Mexico). Op. cit., 1934, *12*, (3), pp. 200–201, fig. 5. Bequaert, 1938, Carnegie Inst. Washington, Pub. No. 499, p. 299 (in part).

Phlebotomus cruciatus Dyar, 1929, Amer. J. Hygiene, *10*, (1), p. 119 (♂, ♀; Panama). Costa Lima, 1932, Mem. Inst. Osw. Cruz, *26*, pp. 21–22. Hall, 1936, Proc. Ent. Soc. Washington, *38*, (2), p. 28 (♂). Galvão and Coutinho, 1940, Rev. Ent., *11*, (1–2), pp. 434, 437, Pl. I, fig. 11 (♀). Barretto, 1946, Rev. Brasil. Biol., *6*, (3), p. 433; 1947, Arq. Zool. Est. S. Paulo, *5*, Art 4, pp. 194–195 (in part). Not *P. cruciatus* Coquillet, 1907.

Phlebotomus yucatanensis var. *baduelensis* Floch and Abonnenc, 1941, Inst. Pasteur de la Guyane, Pub. No. 15 (♂); 1941, op. cit., Pub. No. 28, pp. 1–3, fig. 1 (♀).

Phlebotomus baduelensis Floch and Abonnenc, 1944, Inst. Pasteur de la Guyane, Pub. No. 90, pp. 1–4, figs. 1–2, (♂, ♀; French Guiana); 1944, op. cit., Pub. No. 95, p. 3, fig. 1c (anomalous ♂); 1945, op. cit., Pub. No. 100, p. 7, Pl. 2 (♀). Barretto, 1946, Rev. Brasil. Biol., *6*, (4), pp. 527–529.

Phlebotomus longipalpis Ristorcelli and Dao Van Ty, 1941, An. Parasit. Hum. Comp., *18*, (4–5–6), pp. 252–255, fig. 1 (♀; Narino, Colombia). Not *P. longipalpis* Lutz and Neiva 1912.

Phlebotomus villelai Mangabeira, 1942, Mem. Inst. Osw. Cruz., *37*, (2), pp. 196–201, figs. 131–146 (♂; Ceara and Para, Brasil).

Through the kindness of Mr. Paul Freeman we have been able to have Panama material compared with Newstead's Types at the British Museum. Mr. Freeman writes that the Types are not in very good condition and the staining is very faint. The male agrees with our material in details of the genitalia, including the hairs on the inner aspect of the coxite, and the genital filaments appear to be the same. Mr. Freeman was kind enough to measure the wings of the two males and a female from the type lot; his figures are included in the subjoined table (Table II). As will be seen, Newstead's specimens are rather smaller than the average of Panama specimens, but fall within the range of variation of our material. The palpi in the types are twisted and distorted, but Mr. Freeman believes they have the same structure and formula as our material. The female types were apparently not well cleared before mounting, and neither the cibarium nor spermathecae were visible. The wing measurements, however, fall within the range of variation of our series. Mr. Freeman was unable to make out the structure of the ascoids in the poorly stained types. We believe, therefore, that, at least in the case of the males, the above synonymy is correct. We are unable to consider the characters used to separate *baduelensis* Floch and Abonnenc, 1941 (=*villelai* Mangabeira, 1942) from *yucatanensis* Galliard of specific value as we believe that it is very probable that Galliard either overlooked the fine hairs on the inner aspect of the coxite or did not consider their presence worthy of mention. Even should a re-examination of Galliard's types prove their complete absence, their numbers are so variable in the material we have seen that we feel that at most they might be used to differentiate a geographic race or subspecies.

In the case of the females, little can be said. Remounting of Newstead's types would be of interest, but it might not prove that they were the same species as the male. The wing and palpal measurements are in fair agreement, but these characters are not definitive. Theodor's (1932, Bull. Ent. Res., 23, p. 22, fig. 8 c, d) description of females from Trinidad which he thought might be *trinidadensis* helps little, as his specimens were certainly not like the females which Galliard, Floch and Abonnenc and we have associated with *trinidadensis* males.

TABLE II

MEASUREMENTS IN MICRA

P. trinidadensis

	Panama Material								
	Maximum		Minimum		Mean		Cotype	Paratype	Cotype
	♂	♀	♂	♀	♂	♀	♂	♂	♀
Ant. III	260	240	200	196	228	221	....	....	....
Palpi I + II	144	148	112	120	130	136	....	....	....
Palpi III	148	152	112	136	131	140	....	....	....
Palpi IV	116	116	100	100	105	109	....	....	....
Palpi V	348	380	260	300	312	337	....	....	....
Head height	220	236	200	212	211	222	....	....	....
Clypeus	116	120	108	104	112	113	....	....	....
Proboscis	152	188	140	168	146	174	....	....	....
Eye height	176	196	156	168	165	182	....	....	....
Wing length	1650	760	1380	1670	1490	1710	1420	1540	1600
Alpha	342	486	288	396	277	437	260	300	372
Beta	306	288	216	234	248	268	224	210	310
Gamma	288	306	234	252	261	279	270	250	240
Delta	162	270	126	162	136	214	100	100	200

Dyar's synonymizing of *trinidadensis* with *cruciatus* was based on wholly insufficient data, as Galliard and Theodor pointed out. We have seen both the Types of *cruciatus* Coq. and material from Venezuela and Panama determined by Dyar as *trinidadensis*. Dyar's males at least were *trinidadensis* in the present sense.

The description of *P. longipalpis* Lutz and Neiva given by Ristorcelli and Dao Van Ty agrees very closely with our material, differing only in slightly shorter measurements for the palpi and a somewhat longer *delta*. The very characteristic cibarium and spermathecae lead us to believe that their single specimen was *trinidadensis*. Coutinho (1940, Rev. do Museu Paulista, 1, p. 334, figs. 8, 9) has figured material from Ceara near the type locality of *longipalpis* and his figures show a totally different species from that determined as *longipalpis* by Ristorcelli and Dao Van Ty.

P. trinidadensis is difficult to place in any group within the genus. The males seem closest to such species as *rorotaensis*, F. and A., *oswaldoi* Mang., *peresi* Mang. and *longipennis* Barr., in fact the differences between these species are slight indeed. This group grades into such species as *vexator* Coq. *noguchii* Shnn. and *stewarti* Mang. and Gal.

which have clearly marked non-deciduous hairs on the base of the coxite. Barretto (1946) has recently given a key to the males of species with five spines on the style. In the case of the females the picture is not at all clear. *P. oswaldoi* has been reared by Mangabeira (1942) and the female differs in important respects from females associated with the males of *trinidadensis* by Galliard, Floch and Abonnenc and ourselves, since it lacks the spinose pharynx, and has quite different spermathecae, though the cibarium is somewhat similar. Females thought to be those of *rorotaensis* by Floch and Abonnenc (1944, Inst. Pasteur Guyane, Pub. No. 90, p. 6, fig. 4) are very similar to those of *oswaldoi* Mang. and have been placed in the synonymy of the latter by Barretto (1947), though he retains the male as a distinct species. Floch and Abonnenc (1944) describe and figure, without naming, a female which they suspect may be the female of *peresi* Mang. This species has the pharynx and cibarium essentially as in *trinidadensis* Newst., and the spermathecae, though annulate, are of a similar shape. Putative females of the other species with 5-spined styles show widely different spermathecae, different cibaria and unarmed pharynges. As has often been pointed out, association of the sexes of *Phlebotomus* without actual bred material is always uncertain. In the case of the present species, however, this uncertainty seems to us small, and the rather unusual structure of the female cibarium and pharynx would seem to indicate a less close relationship to other species than might be postulated from the quite similar males.

The species has a wide range, being now definitely known from Brazil, Trinidad, French Guiana, Venezuela, Colombia, Panama and Yucatan. In Panama it is one of the most abundant species, having been taken in practically every month of the year and from a wide variety of habitats. It seems to be the dominant species in tree buttresses, where it outnumbers all other species combined. It has not been taken biting, or in animal baited traps,, nor is it an ordinary frequenter of animal burrows and bat trees, so that we have no hint as to its preferred hosts.

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Mangabeira, O., and **Galindo, P.** 1944. The Genus *Flebotomus* in California. Amer. J. Hygiene, 40, (2), pp. 182–198, Pl. I–III.

Rozeboom, L. E. 1940. *Flebotomus suis*, a new Flebotomus from Panama. Amer. J. Hygiene, 32, (1), Sec. C, pp. 8–11, figs. 1–5.

THE EFFECT OF TEMPERATURE ON THE FREQUENCY OF BEAT OF THE GRASSHOPPER HEART

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The effect of temperature on the rate of beat of the adult insect heart apparently has not been studied previously. However, there have been two investigations concerning the heart beat of nymphal cockroaches. Fries (1927) found a μ value of 12,500 for the heart of intact Blatta orientalis nymphs between 10° and 38°C. Steiner (1932) found that the heart beat of Periplaneta americana nymphs gives values of about 12,000 between 15° and 30°C in the intact animals, about 9,000 in decapitated but otherwise intact animals, and various values between 5,800 and 11,300 in decapitated animals in which the heart and / or ventral nerve cord had been severed in the mid region of the body.

The "accessory" hearts in the swimming legs of Notonecta have been studied by Crozier and Stier (1927) who found that the isolated legs between 6° and 19°C usually give μ values of 8,200, 16,200, or 32,200 but sometimes 11,400, 19,800, or 24,500. Such preparations are obviously not under control of the central nervous system.

The effect of temperature on heart beat frequency of insect larvae has also been investigated. Crozier and Federighi (1925) found a temperature characteristic of 12,200 for the intact silkworm between 6° and 36°. Koizumi (1928) found values of 7,500, 8,900, and 13,100 for Chironomus larvae, and later found values of 10,300 and 16,700 for Aedes and 10,700 and 15,400 for Mochlonyx (Koidsumi, 1931). With caddis fly larvae Federighi (1937) obtained a value of 12,500 between 2° and 20°C with one specimen, and 13,500 with four others.

Temperature characteristics have also been determined for the heart beat of other invertebrates. Adult intact Limulus usually gives a value of 12,200 and sometimes a higher value (23,500) below 15°C (Crozier, 1924; Crozier and Stier, 1927; from data of Garrey). However, in the embryo before the heart is innervated the values are 11,500, 16,400, 20,000, or 25,500. Asellus has a value of 32,000 between 6° and 16°C (Crozier and Stier, 1927) and Ciona, values of 8,000, 12,000, and 16,000 below 30°C. (Wolf, 1932).

The heteropod Pterotrachea has a value of 11,200 and the pteropod Tiedemannia one of 16,200 (Glaser, 1926). The heart of Anodonta has a value of 11,200 (Crozier and Stier, 1925, data of Koch). Freshly collected Limax yields values of 11,500 in December and 16,300 in March, but the December value can be raised reversibly to 16,200 by feeding sugar (Crozier and Stier, 1926). In Daphnia the μ value varies from 6,700 to 35,000 (Stier and Wolf, 1932). Other citations are given by Bělehrádek (1935).

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MATERIALS AND METHODS

The animals used in the present experiments were adult laboratory grown grasshoppers, Melanoplus differentialis. The grasshoppers were decapitated and opened from the ventral side, the digestive and reproductive systems and other outlying tissues were removed, and the dorsal tubular heart exposed. The rate of heart beat was measured from records of the electrocardiogram taken from these preparations. The heart was covered with Belar's solution, and four Ag-AgC1 electrodes were placed in direct contact with the heart at four segmental levels, thereby furnishing dipolar input voltages for three channels of amplification. A fourth channel was used as a timing signal, and permanent records were made by an Offner Crystograph. The electrocardiogram of the grasshopper has been described previously (Jahn, Crescitelli, and Taylor, 1937; Crescitelli and Jahn, 1938).

The temperature chamber consisted of a bakelite box lined with coils of copper tubing. The temperature of the chamber was controlled by forcing hot or cold compressed air through the coils, and the temperature was measured with a mercury thermometer with the bulb at the level of the heart.

It was found that when the temperature was altered by 2°C the heart usually adjusted to the new rate within two minutes. Ordinarily the heart was maintained at each temperature for three minutes or longer. When the temperature was changed from one of the extremes back to room temperature, thirty minutes was necessary for a steady rate at room temperature to be established; forty minutes was usually allowed. Each preparation was subjected to a graded series of temperatures, beginning at room temperature and going to one extreme, either hot or cold, and the electrocardiogram was recorded at each step. The temperature was then changed to that of the room for forty minutes or longer. Sometimes there was a "hysteresis effect" in that the initial room temperature rate was not quite resumed upon return from either extreme back to room temperature. However, a few degrees beyond room temperature toward the other extreme the rate usually returned to an appropriate value. In these cases the temperature shift toward the other extreme was then continued and records were again made every few degrees. In other preparations the return to the initial room temperature rate was quickly established. No significant difference was noted between those subjected first to low and then to high temperatures as long as the temperatures did not go below 0°C or above 50°C.

RESULTS

The overall range of temperatures used was approximately 0° C. to 50–54° C. There was some variation in the temperatures at which the heart beat of individual preparations ceased to be recognizable from the electrocardiogram. Thus, in one of the animals, the beat became imperceptible at 7°; whereas for most, the heart maintained a beat between 0 and 1° with the rate reduced to about 10–12 beats per minute from an average of 65 at 27° C. The method of experimentation precluded the study of the effect of lower temperatures on the heart because of the freezing point of Belar's solution. However, since Belar's solu-

tion is approximately isotonic with the heart tissue the temperature at which the heart would cease (the "biological zero") is only slightly below 0° C. An interesting but unexplained phenomenon was the occasional degeneration of a beat which had been slow but strong at 0–5°, when the temperature was raised a degree or two in the first step toward return to room temperature. This effect was noted in several hearts, but the cause was not investigated.

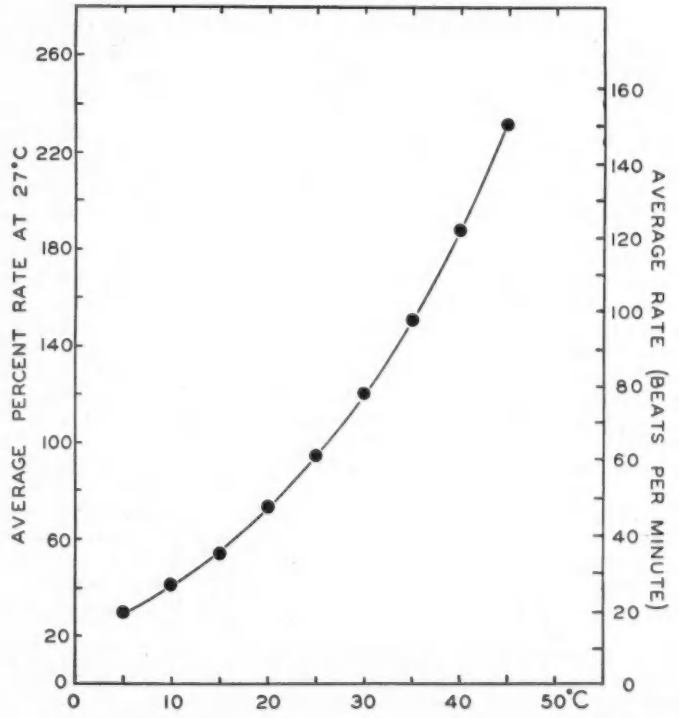

FIG. 1. The average rate of beat of twelve "typical" grasshopper heart preparations as a function of temperature. Ordinate on left in per cent at 27° C; ordinate on right in beats per minute.

At the upper end of the temperature range, there was as much variability in response. One heart degenerated irreversibly at approximately 40° while other hearts continued to beat above 50° and retained the ability to return to the initial rate at room temperature.

In the present study the heart rate as a function of temperature was determined for twenty-eight heart preparations. In twelve preparations the temperature range used was either room temperature to about 5° or room temperature to 40–50° C. For sixteen preparations the

range was more than 30°, usually 5–10° to 40–50°. The results of the short range experiments were within the limits of those of the long range experiments; therefore only the latter are considered in the present paper.

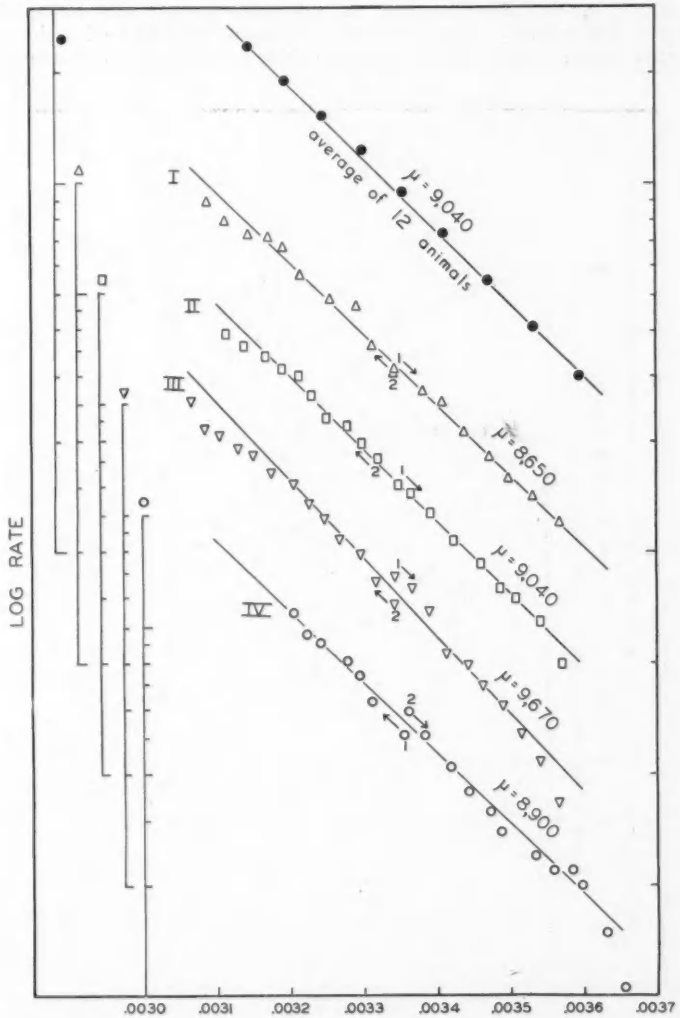

FIG. 2. Log of rate plotted against reciprocal of absolute temperature to test van't Hoff-Arrhenius equation. Upper curve: average of twelve preparations, date of fig. 1. Curves I to IV: individual data included in upper curve.

Of the sixteen preparations which were studied over a wide temperature range, twelve yielded fairly uniform results; so that it seemed permissible to average the data. The other four preparations yielded results which differed appreciably from the twelve "typical" experiments, and also from each other, so as to warrant separate treatment.

The results of the twelve typical experiments are summarized in fig. 1. The individual data for each experiment were plotted with rate against temperature. Then smooth curves were drawn through the

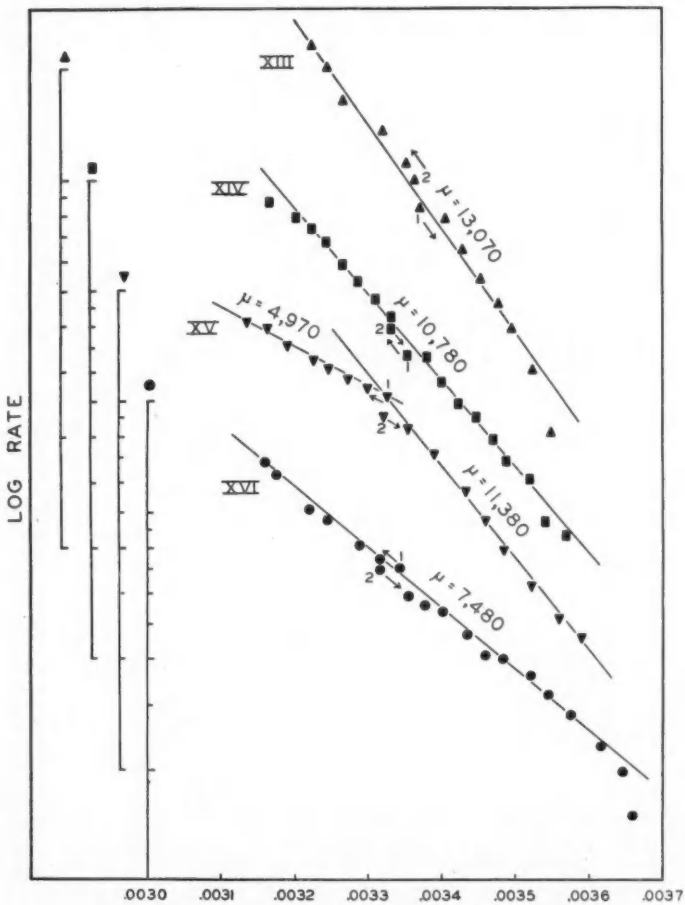

FIG. 3. Log of rate plotted against reciprocal of absolute temperature for four "atypical" preparations not included in the averaged date of fig. 1.

points and the value for 27° was interpolated. With this as 100% the other values were then replotted on a percentage scale and the value for each 5° interval between 5° and 45° was determined by interpolation. These average values are shown in fig. 1. The left-hand ordinate shows the percentage in terms of 27° and the right-hand ordinate shows the equivalent value in beats per minute, with sixty-five beats per minute, the average at 27°, taken as one hundred per cent. Individual rates at 27° varied from 55 to 80. This graph shows the trend of average data.

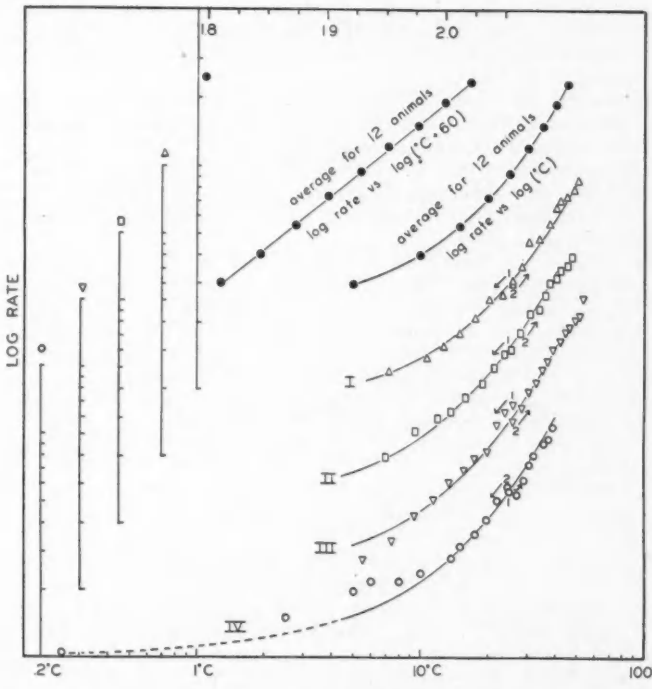

FIG. 4. The five lower curves are the same data as fig. 2, plotted as log rate against log Centigrade temperature to test Bělehrádek equation. The uppermost curve is log rate plotted against °C + 60 to test Bělehrádek equation with "biological zero" of —60° C.

Fig. 2 shows the log of the rate plotted against the reciprocal of the absolute temperature for the purpose of testing the fit of the van't Hoff-Arrhenius equation. Represented on this graph are individual data for four of the twelve typical experiments and also the average from fig. 1. The four sets of data shown are typical of the series of twelve and show some of the variation encountered. On the graph the small numbers 1 and 2 and the neighboring arrows denote the direction in which

the temperature was changed. In curve 1 the first point obtained is labelled "1," and the arrow denotes that the temperature was lowered. After the rate at the lowest temperature was determined the temperature was raised to approximately room temperature, the point labeled "2" was obtained, and subsequently those at higher temperatures. All of the typical data are fitted quite well by single straight lines except for the extremes where the points tend to fall below the line. The data, however, are not adequate to warrant the fitting of separate lines for the extremes. Curves I and III with μ values of 8,650 and 9,670 represent the lowest and highest values that were averaged to order to obtain the average value of 9,040 typified by curve II. The points for the averaged data show a slight curvature, but they are closely approximated by a straight line between 5° and 45°.

Fig. 3 shows the data from four experiments which seemed consistent within themselves but which differred sufficiently from those of figs. 1 and 2 to warrant separate presentation. Most of the data for three of these preparations can be represented by single straight lines, two with μ values above average (XIII and XIV) and one below (XVI). The data for preparation XV are best represented by two straight lines of slope 4,970 and 11,380.

Fig. 4 shows the same data as does fig 2, i. e., the average and the "typicals", except that, for the purpose of testing the Bělehrădek equation, the points are plotted in a different manner. For the five curved lines the data are plotted as log rate against log temperature in degrees Centigrade. The curves drawn through the individual data (Curves I to IV) have the same slope and curvature as that drawn through the average for the twelve typical preparations. If the simpler form of Bêlehrádek equation (with "biological zero" equal to zero Centigrade) were applicable, these curves would be straight lines; obviously they are not.

The Bělehrádek equation can be made to fit certain other data (e. g., photosynthesis of Prunus, see Bělehrádek, 1935) by assuming a biological zero somewhat different from zero Centigrade. However, in order to convert the curves of fig. 4 into straight lines by this method it is necessary to assume a biological zero about −60°C. The effect of such a calculation is shown at the top curve of fig. 4 where log rate is plotted against log (°C + 60). The lowest temperature at which the grasshopper heart will beat has not been determined experimentally, but it is certainly very much closer to 0°C. than to −60°C. The "calculated" "biological zero" of −60°C is probably of no value except to prove the inapplicability of the Bělehrádek equation to the present data.

Q_{10} values calculated from the averaged typical data of fig. 1 are as follows:

Temperature range	Q_{10}
5–10° C	1.83
10–15° C	1.78
15–20° C	1.80
20–25° C	1.67
25–30° C	1.64
30–35° C	1.58
35–40° C	1.55
40–45° C	1.52

It is apparent from these values that there is a gradual decrease of Q_{10} with increase of temperature from a maximum of 1.83 for 5-10°C to 1.52 for 40-45°C

DISCUSSION

Most of the interest in the effect of temperature on heart beat frequency has centered around the following questions:

1) Does the change in frequency with temperature follow the van't Hoff-Arrhenius equation? Usually yes, (cf., however, Bělehrádek, 1929, 1935)

2) Does the temperature characteristic change with removal of all or part of the central nervous system? Yes, at least in some instances, e. g., cockroach (Steiner, 1932).

3) Can the value of the temperature characteristic be used to indicate whether the beat is neurogenic or myogenic? Indicative but equivocal. The value 12,000 is often encountered in invertebrate nervous systems, and also in the heart when under nervous control. However, this value also occurs elsewhere, and if it has a real meaning it is probably more indicative of a particular metabolic process than of the histological type of tissue.

4) Can the μ value be changed by methods which do not involve removal of the influence of the nervous system? Yes, e. g., in Limax the value can be changed reversibly from 11,500 to 16,300 by feeding of sugar (Crozier and Stier, 1926).

5) Are the μ values the same for different processes in the same animal? That is, is there a central control of all μ values? Not necessarily, e. g., in Daphnia the μ values for both heart beat and respiratory movements vary from 6,500 to 30,000 or more, and there is no obvious relationship between them, i. e., the ratio of the two μ values varies from one individual to another (Stier and Wolf, 1932). In Asellus between 4° and 15°C the value for heart beat is 32,300 and that for gill movements only 16,000 (Crozier and Stier, 1927).

The very intriguing question of what effect different values for closely related phenomena such as heart rate and respiratory movements would have on the chemical equilibria of the animal's blood or other tissues has not been the subject of investigation.

The only published experiments which seem to have a direct bearing on the present ones are those of Fries (1927) and Steiner (1932) on the cockroach heart. Both of these investigators found μ values of about 12,000 for intact animals. In addition Steiner (1932) found that decapitated but otherwise intact animals gave μ values of 8,500-9,000; section of the nerve cord or heart at the thoraco-abdominal junction of decapitated animals raised these values to 10,000-11,000; electrical stimulation of the neck, however, lowered the values for the thorax to 5,800-7,400, but not those for the abdomen.

Steiner's values for decapitated but otherwise intact cockroaches are within the limits of the twelve "typical" heart preparations of the present data. However, since no data on intact grasshoppers are available it is impossible to state whether this similarity of values is coincidental or is caused by a similarity in the metabolic processes of the two hearts.

The respiratory rate of Melanoplus yields μ values of 7,900 when the

animal is intact and 16,500 or 11,300 when decapitated (Crozier and Stier, 1925a). Comparable values for the heart are not available.

It is obvious from figs. 2, 3, and 4 that the van't Hoff-Arrhenius equation describes the present data much better than does that of Bělehrádek. The fact that the data can be fitted by the Bělehrádek equation if the absurd value of −60°C for "biological zero" is assumed should serve as adequate warning against such a procedure unless the real value of "biological zero" has been determined experimentally.

SUMMARY

1. The rate of beat of the grasshopper heart has been determined from electrocardiograms of preparations consisting of the tubular heart and the body wall of the thorax and abdomen.

2. The average rate varies from 20 beats per minute at 5° to 150 at 45°C. Near zero the heart slows to about 10 beats per minute. Above 45° the rate continues to rise at least as high as 53°C.

3. Most of the data can be fitted quite well by the van't Hoff-Arrhenius equation with a μ value of about 9,000, but not by the Bělehrádek equation unless the absurd value of −60°C is assumed for the "biological zero". Four typical preparations yielded μ values of 5,000 to 13,000.

4. Q_{10} values decrease with rising temperature from 1.83 at 5−10°C to 1.52 at 40-45°C.

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A REVISION OF THE NORTH AMERICAN ANTS OF THE GENUS MYRMICA LATREILLE WITH A SYNOPSIS OF THE PALEARCTIC SPECIES. II.

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Swarthmore College,
Swarthmore, Pa.

The preceding part with this title was published in the Annals of the Entomological Society of America, September, 1947 (40: 437–474, 3 text figs.). It treated the genus as a whole (keys, distribution, affinities, etc.) and thirteen species comprising fifty described forms. The species were palearctic except for three forms of *Myrmica laevinodis* Nylander found in three localities on the east coast of North America which were probably importations in historic times.

The present part deals with seven species comprising fifty-four described forms. Seven of the latter are nearctic and include three of the common ants of North America (*Myrmica lobicornis fracticornis* Emery, *M. sabuleti americana* Weber and *M. schencki emeryana* Forel). They are North American equivalents of common Eurasian species. Locality lists of these are included and a brief account of their biology, variations and anomalies.

THE HOLARCTIC SPECIES OF MYRMICA LATREILLE
(Continued)

Myrmica sulcinodis Nylander

M. Sulcinodis Nylander, Acta. Soc. Sc. Fennicae, 1846, *2:* 934–935, ♥ ♀; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 86–88, fig. 3, ♥ ♀ ♂; Karawajew, Konowia, 1926, *5:* 283; Stärcke, De Levende Natuur, 1927, 13; Kuznetzov-Ugamskij, Zool. Anz., 1929, *83:* 45.

Worker (after Nylander): Length ca. 2 lin.

In general, similar to the preceding (*M. lobicornis*), but paler, antennal scapes and pedicel otherwise formed. Frontal area obscured, traversed by striae. Frontal laminae a little less dilated below the margins. Antennal scapes a little curved at the base, nevertheless more than in *M. laevinodis*.

Epinotal spines very long, subulate. Pedicel longitudinally sulcate with coarse sulcations, about 12 in number and regular (not confused as in *laevinodis*).

Female (after Nylander): Length 2½ lin.

Similar to the preceding female (*laevinodis*) with the differences noted in the worker. Head as in the worker. Epinotal spines long, subulate, slightly curved. Pedicel laterally, regularly and deeply sulcate. (Wings absent).

Male (after Emery): Length 5–5.5 mm.

Color as in *rubra*; sculpturing rougher and thicker; the entire thorax dull and striate; petiole wrinkled, somewhat dull; part of the postpetiole

shining. Antennae more slender than in *M. rubra*, the scape not quite half as long as the funiculus (equal to the 6 following joints together); club indistinctly 4–5–jointed.

Distribution: Northern Europe and Asia and in the Pyrenees, Alps, Apennines, Balkans and Caucasus.

Myrmica sulcinodis subsp. **nigripes** Ruzsky

M. sulcinodis var. *nigripes* Ruzsky, Berlin. Ent. Zeitschr., 1896, *4:* 73, ♀ ♂; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 88.

Worker (after Ruzsky):

Differing from the typical form mainly through the black or blackish brown legs; tarsi light, color in general darker, the body more wrinkled.

Type Locality: Orenburg Urals: High ridge of the Kumatsch.

"Males and females in July" (not described).

According to Emery the worker thorax is ferruginous, the head, pedicel and gaster blackish brown, the antennae and legs brown; the sculpturing is stronger and more regular than in the type; the petiolar node somewhat shorter.

The male is darker and more strongly sculptured than in the type; the petiole is more strongly furrowed longitudinally, the postpetiole thickly punctate, dull.

Emery lists South Russia and West Siberia.

Myrmica sulcinodis var. **sulcinodo-ruginodis** Forel

M. sulcinodis var. *sulcinodo-ruginodis* Forel, Fourmis Suisse, 1874: 77, ♀; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 88.

Forel erected this name for the ants intermediate between *sulcinodis* and *M. rubra* (= *M. ruginodis*).

Myrmica sulcinodis var. **sulcinodo-rugulosa** Nassonov

M. sulcinodis var. *sulcinodo-rugulosa* Nassonov, Trav. Lab. Zool. Univ. Moscow, 1889, *4:* 35, ♀.

Similarly erected by Nassonov for the ants intermediate between *sulcinodis* and *M. rugulosa*.

EXPLANATION OF PLATE I

Fig. 1. Body outline and antennal scape of the worker of *Myrmica laevinodis* var. *bruesi* Wheeler. Fig. 2. Body outline and antennal scape of the worker of *Myrmica scabrinodis* subsp. *mexicana* Wheeler. Fig. 3. Body outline and antennal scape of the worker of *Myrmica lobicornis* subsp. *fracticornis* Emery. Fig. 4. Body outline and antennal scape of the worker of *Myrmica sabuleti* subsp. *americana* Weber. Fig. 5. Body outline and antennal scape of the worker of *Myrmica sabuleti* subsp. *hamulata* Weber. The lamina at the bend of the scape is prolonged into a hook is diagnostic. Fig. 6. Body outline and antennal scape of the worker of *Myrmica sabuleti* subsp. *nearctica* Weber. The lamina at the bend of the scape extends farther than in *americana*. Fig. 7. Body outline and antennal scape of the worker of *Myrmica schencki* subsp. *emeryana* Forel. Fig. 8. Body outline and antennal scape of the worker of *Myrmica schencki* subsp. *tahoensis* Wheeler.

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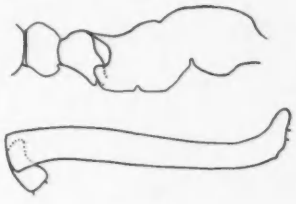

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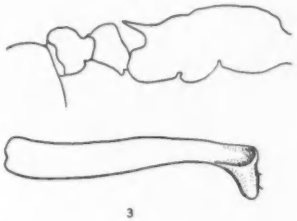

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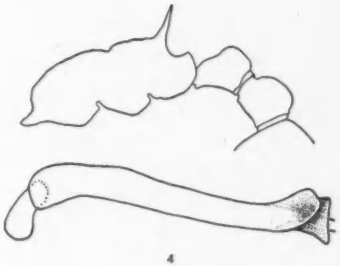

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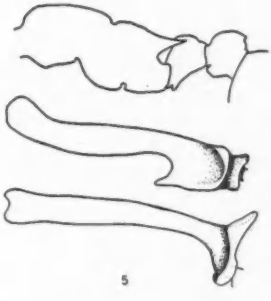

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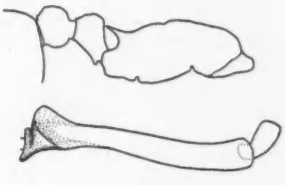

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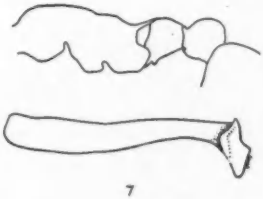

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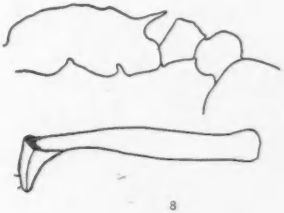

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Myrmica sulcinodis var. **sulcinodo-scabrinodis** Forel

M. sulcinodis var. *sulcinodo-scabrinodis* Forel, Fourmis Suisse, 1874: 77, ☿; Starcke, "De Levende Natuur," 1927: 13, ☿.

A name for the ants intermediate between *M. sulcinodis* and *M. scabrinodis*.

Myrmica sulcinodis subsp. **vicaria Kuznetzov-Ugamskij**

M. sulcinodis subsp. *vicaria* Kuznetzov-Ugamskij, "The Ants of the South Ussuri Region (in Russian)," 1928: 33, figs. 13, 14, ☿.

Worker (after Kuznetzov-Ugamskij): Length 3.7–4 mm.

Epinotal spines shorter than the basal surface of the epinotum; broad at the base, then strongly tapering to a pointed apex. Smaller than the typical form: length 4–4.5 mm. Declivous surface of the epinotum infraspinally smooth and strongly shining. Metasternal angles somewhat produced dorsally and pointed.

Type Locality: Ssutscham.

Myrmica myrmecophila Wasmann

M. myrmecophila Wasmann, Biol. Centralbl., 1910, *30:* 516, ♀; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 91.

Ergatoid Female (after Wasmann and Finzi): Length 5.2 mm.

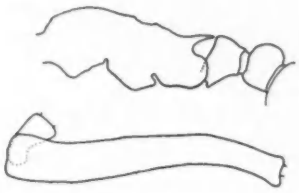
Head clearly smaller and lighter (than in *sulcinodis*), yellowish brown, a brownish cast only in middle of frons. Occiput bears medially an ocellus which is much smaller than in ♀ and ♂ *sulcinodis*. Frontal area more concave. Thorax as in ☿ *sulcinodis*, but gaster much larger (2.4 mm. long, 1.3 mm. broad). Epinotal spines longer than in *sulcinodis*, extending to middle of petiole, horizontal, parallel. Postpetiole, from above, twice as broad as the petiole. Circumference of gaster equal to that of a queen *sulcinodis*, in the same colony, which is almost 7 mm. long, while the head is only half the size. Sculpture of head and thorax corresponds to that of ♀ and ♂ *sulcinodis* but somewhat less coarse. Upright yellow hairs somewhat longer and thicker.

Tyrol: Arlberg Pass, 1,800 m., 27.VIII.91, from a flourishing *M. sulcinodis* colony (E. Wasmann).

Wasmann believed this peculiar ant may have been parasitic on the *sulcinodis*. Unfortunately, no other records are known.

EXPLANATION OF PLATE II

Fig. 1. Body outline and antennal scape of the worker of *Myrmica brevinodis* Emery. Fig. 2. Body outline and antennal scape of the worker of *Myrmica brevinodis* subsp. *sulcinodoides* Emery. Fig. 3. Body outline and antennal scape of the worker of *Myrmica brevinodis* subsp. *kuschei* Wheeler. Fig. 4. Body outline and antennal scape of the worker of *Myrmica brevinodis* subsp. *brevispinosa* Wheeler. Fig. 5. Body outline and antennal scape of the worker of *Myrmica brevinodis* subsp. *discontinua* Weber. Fig. 6. Body outline and antennal scape of the worker of *Myrmica wheeleri* Weber. Fig. 7. Body outline and antennal scape of the worker of *Myrmica punctiventris* Roger. Fig. 8. Body outline and antennal scape of the worker of *Myrmica punctiventris* subsp. *pinetorum* Wheeler.



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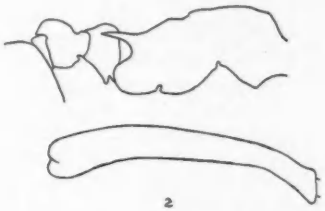

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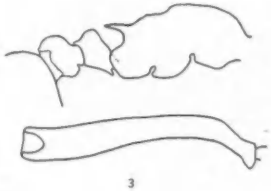

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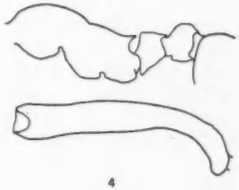

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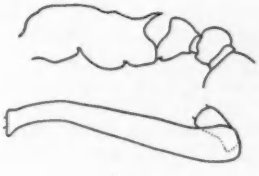

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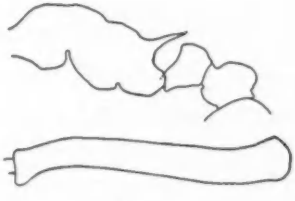

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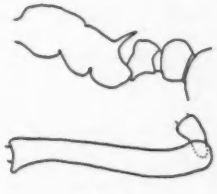

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Myrmica lobicornis Nylander

M. lobicornis Nylander, Act. Soc. Sc. Fennicae, 1846, *2:* 933–934, pl. 18, figs. 32, 33, ♂ ♀; Stärcke, Ent. Bericht. Nederl. Ent. Vereen., 1926, *7:* 89–91; Starcke, "De Levende Natuur," 1927: 15; Starcke, Tijdschr. Ent., 1927, *70:* 73–84, 5 figs; Karawajew, Konowia, 1926, *5:* 283; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 106–107, fig. 13; Santschi, Rev. Suisse Zool., 1931, *38:* 347–348.

Worker (after Nylander): Length 1⅔–2 lin.

Similar to the preceding (*M. scabrinodis*) but less strongly robust, color and shape of the scape also distinct. Mandibles pale ferruginous, at the extreme apex fuscous. Frontal area conspicuous. Frontal lamina as in the preceding, margins dilated, a little reflexed. Antennae as dark as the mandibles, rufous; scape with compressed lobe which is a little concave, in the form of an almost semi-circular lamina, and situated in a transverse position above the bend near the base. This lobe is a little larger, more compressed, and not obliquely situated as in the preceding. Head laterally reticulate-rugose. Thorax and pedicel longitudinally, coarsely and roughly sculptured, sordid brownish ferruginous; nodes coarsely and irregularly rugose. Apex of gaster pale.

Female (after Nylander): Length 2½ lin.

Similar to the female of the preceding (*M. scabrinodis*), but colored otherwise and scape distinct.

Apex of the mandibles pale rufous. Frontal area, frontal laminae and antennal scapes as in the worker. Thorax fuscous, pronotum anteriorly with coarse, irregular rugosities, otherwise longitudinally and coarsely striate, base of the sculpturing and apically faintly brownish-rufous. Nodes fuscous, brownish-rufous between the coarse, sub-longitudinal rugosities. Wings as in the preceding, but tinted with still paler cinereous; 2⅓ lin. long. Legs shining, pale ferruginous, with long yellowish pubescence. Apex of gaster pale fusco-rufescent.

Male (after Emery):

Very distinguishable in the formation of the antennae: the funiculus is short, the scape about half as long as the funiculus (equal in length to the following six segments together) and, at the basal third, angularly bent.

Distribution: North Europe to Central Asia; Alps, Apennines.

Figure 32a of Nylander's description is of an antennal scape in posterior view; the scape is bent obtusely and the lamina appears as a high, but rounded, tubercle in profile. Figure 32b shows the lamina from above; it appears transversely elliptical with the basal margin

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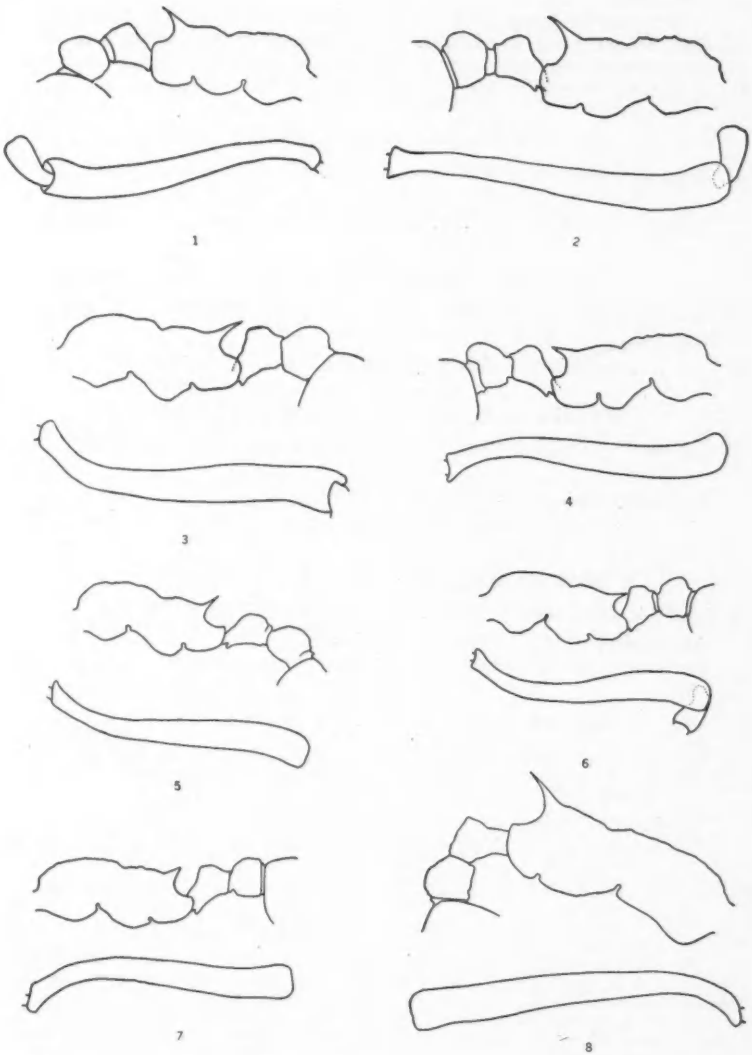
EXPLANATION OF PLATE III

Fig. 1. Body outline and antennal scape of the worker of *Myrmica rubra* (L.). Fig. 2. Body outline and antennal scape of the worker of *Myrmica rubra* var. *silvestrii* Wheeler. Fig. 3. Body outline and antennal scape of the worker of *Myrmica rubra* subsp. *yoshiokai* Weber. Fig. 4. Body outline and antennal scape of the worker of *Myrmica laevinodis* Nylander. Fig. 5. Body outline and antennal scape of the worker of *Myrmica smythiesi* Forel, cotype. Fig. 6. Body outline and antennal scape of the worker of *Myrmica smythiesi* subsp. *dshungarica* Ruzsky. Fig. 7. Body outline and antennal scape of the worker of *Myrmica smythiesi* subsp. *himalayana* Weber. Fig. 8. Body outline and antennal scape of the worker of *Myrmica smythiesi* subsp. *hecate* Weber.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straight. Figure 33 shows the frontal area as an isoceles triangle with concave basal margin.

The ***lobicornis*** male genitalia are similar to those of ***scabrinodis, sabuleti, schenck:*** and ***brevinodis.*** For this reason and because of frequent intermediate conditions in the worker castes they may perhaps be considered closely related species capable of hybridizing.

Myrmica lobicornis subsp. **alpestris** Arnoldi

M. lobicornis subsp. *alpestris*, Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 168, ☿ ♂.

A form from the U. S. S. R. unknown to me.

Myrmica lobicornis subsp. **alpina** Stärcke

M. lobicornis subsp. *alpina* Stärcke, Tijdschr. Ent., 1927, *70:* 80–81, fig. 2, ☿ ♀.

Val Aosta.
For a description of this form see the reference above.

Myrmica lobicornis subsp. **angustifrons** Stärcke

M. lobicornis subsp. *angustifrons* Stärcke, Tijdschr. Ent., 1927, *70:* 81–82, fig. 3, ☿ ♀.

England: Surrey: Weybridge (H. Donisthorpe).
For a description of this form see the reference above.

Myrmica lobicornis subsp. **apennina** Stärcke

M. lobicornis subsp. *apennia* Stärcke, Tijdschr. Ent., 1927, *70:* 82–83, ☿.

Appennines: Monte Cimone (C. Menozzi).
For a description of this form see the reference above.

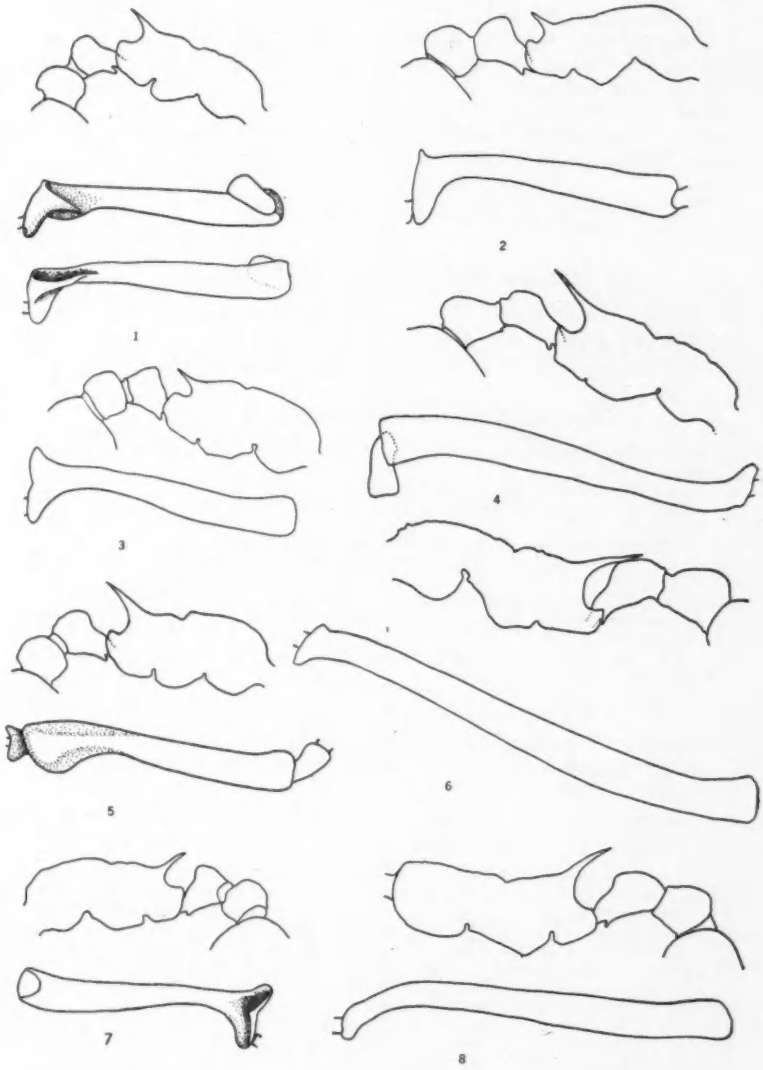
Myrmica lobicornis subsp. **arduennae** Bondroit

M. lobicornis var. *arduennae* Bondroit, Ann. Soc. Ent. Belg., 1911, *55:* 12, ☿ ♀ ♂.
M. lobicornis st. *arduennae* (Bondroit), Santschi, Rev. Suisse Zool., 1931, *38:* 349–350, fig. 4.

Belgium: Hockay.
For descriptions of this form see the references above.

EXPLANATION OF PLATE IV

Fig. 1. Body outline and antennal scape of the worker of *Myrmica scabrinodis* Nylander of Europe. Fig. 2. Body outline and antennal scape of the worker of *Myrmica moravica* Soudek. Fig. 3. Body outline and antennal scape of the worker of *Myrmica lobicornis* Nylander of Europe. Fig. 4. Body outline and antennal scape of the worker of *Myrmica ritae* subsp. *serica* Wheeler. Fig. 5. Body outline and antennal scape of the worker of *Myrmica sabuleti* Meinert of Europe. Fig. 6. Body outline and antennal scape of the worker of *Myrmica ritae* subsp. *formosae* Wheeler. Fig. 7. Body outline and antennal scape of the worker of *Myrmica schencki* Emery of Europe. Fig. 8. Body outline and antennal scape of the worker of *Myrmica ritae* subsp. *indica*, n. subsp.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Myrmica lobicornis subsp. **deplanata** Ruzsky

M. scabrinodis lobicornis var. *deplanata* Ruzsky, Formic. Imp. Rossici, 1905: 700, ☿.

Worker (after Ruzsky):

Differing from the typical *lobicornis* in the near absence of a meso-epinotal impression so that the thorax, in profile, is evenly convex. Epinotal spines shorter, thin, acute. Bend of the antennal scape with a sharper tooth or small, sharp lobe. Postpetiole dorsally nearly smooth, weakly shining and with finer, thinner reticulations. Pilosity sparse, almost entirely absent on the thorax and dorsal surface of the gaster.

Type Localities: Caucasus, Krim, Gouv. Saraton on the steppe; steppe near Orenburg.

Myrmica lobicornis subsp. **foreli** Santschi

M. lobicornis st. *foreli* Santschi, Rev. Suisse Zool., 1931, *38:* 348–349, ☿ ♀.

Type Locality: Tyrol: Schluderbach (Forel). For a description of this form from the Forel collection see the reference above.

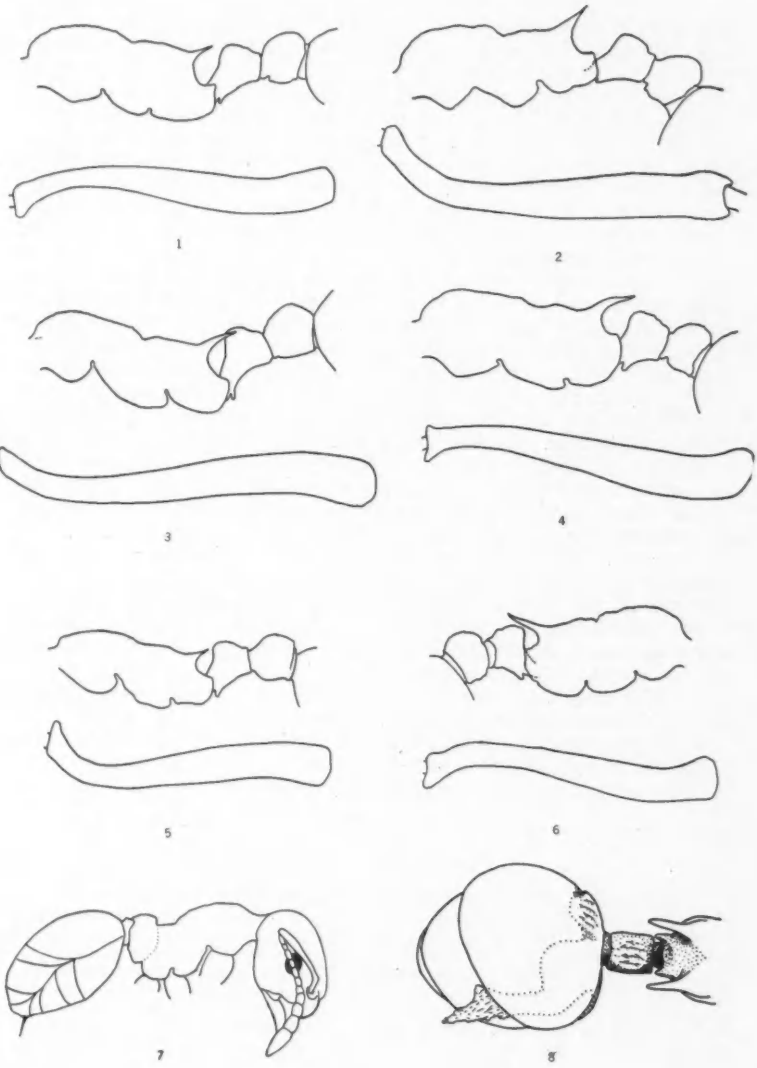
Myrmica lobicornis subsp. **fracticornis** Emery

M. scabrinodis scabrinodis var. *fracticornis* Emery, Zool. Jahrb. Abth. f. System., 1894, *8:* 313, ☿.
M. rubra scabrinodis var. *fracticornis* Wheeler, "Ants," 1910: 566, ☿.
M. scabrinodis scabrinodis detrinodis Emery, Zool. Jahrb. Abth. f. Syst., 1894, *8:* 316, ☿.
M. rubra scabrinodis var. *detritinodis* Wheeler, "Ants," 1910, 566, ☿.
M. sabuleti var. *lobifrons* (In Part), Pergande, Proc. Washington Acad. Sc., 1900, *2:* 521, ☿.
M. rubra scabrinodis var. *lobifrons* (In Part) Wheeler, "Ants," 1910: 566, ☿.
M. scabrinodis lobicornis var. *lobifrons* (In Part) Wheeler, Bull. Mus. Comp. Zool., 1917, *61:* 17, 21, ☿.
M. rubra scabrinodis var. *glacialis* Forel, Ann. Soc. Ent. Belg., 1904, *48:* 154; Wheeler, "Ants," 1910: 566, ☿.
M. scabrinodis lobicornis var. *glacialis* Wheeler, Proc. Amer. Acad. Arts Sc., 1917, *52:* 504, ☿; Wheeler, Bull. Mus. Comp. Zool., 1917, *61:* 21, ☿.

The following descriptions are of a worker cotype from New Haven, Connecticut, and of all castes of a single colony from the Santa Catalina Mountains, Arizona.

EXPLANATION OF PLATE V

Fig. 1. Body outline and antennal scape of the worker of *Myrmica rugosa* Mayr. Fig. 2. Body outline and antennal scape of the worker of *Myrmica rugosa* subsp. *arisana* Wheeler. Fig. 3. Body outline and antennal scape of the worker of *Myrmica pachei* Forel, cotype. Fig. 4. Body outline and antennal scape of the worker of *Myrmica kurokii* Forel. Fig. 5. Body outline and antennal scape of the worker of *Myrmica bergi* Ruzsky, cotype. Fig. 6. Body outline and antennal scape of the worker of *Myrmica sulcinodis* Nylander. Fig. 7. Body outline of an anomalous worker of *Myrmica brevinodis* subsp. *brevispinosa* Wheeler from Montana. The petiole is fused with the epinotum, which lacks the customary spines, and the postpetiole appears to be absent. Fig. 8. Dorsal view of the abdomen of an anomalous alate female of *Myrmica brevinodis* Emery from North Dakota. The red petiole is normal; the red post-petiole, however, is asymmetrically fused with the anterior portion of the brown first gastric segment and its amorphous remains extend out between the first and second gastric segments.



Worker (Cotype): Length 4.9 mm.

Antennal scapes exceeding posterior margin of head by a distance less than the distal diameter of the scape; seen from above, in the form of a drawn-out sigmoid curve, at the base laterally compressed, with a rounded, more or less upright, lamina which extends completely around the base in a transverse position, and extends along both sides of the scape to a distance about equal to the width of the transverse section; seen from behind, the scape is sharply bent at the base in an obtuse angle, the lamina appearing as a slight tooth; distal diameter nearly twice that of the proximal portion; antennal club indistinctly 4-jointed, funicular joints 1 and 2 together equal in length to joints 3–5 together. Thorax, in profile, evenly convex to the deep and distinct mesoëpinotal suture; epinotal spines moderate in length, directed upwards at an angle of about 30 degrees and backwards, straight and acute, shorter than the epinotal declivity ventral to them; from above, moderately diverging, slightly longer than the distance between their bases. Petiole in profile slightly longer from apex of ventral tooth to postpetiole than it is high, with anterior face a little concave, rounded antero-dorsal and postero-dorsal angles and nearly flat top. Postpetiole in profile about 0.7 as long as high, with anteriorly produced ventral lobe; from above subglobular. Gaster long-ovate. Legs moderate in length.

Surface of head moderately sculptured, median dorsal area longitudinally rugose, sides and posterior surface irregularly reticulate-rugose, whole surface thickly and conspicuously punctate at the base of the sculpturing; frontal area clearly delimited, punctate, striated at the margins. Surface of the thorax deeply vermiculate-rugose, more regularly rugose posteriorly and less deeply sculptured on the sides. Surfaces of the petiole irregularly vermiculate, distinctly punctate. Dorsal surface of the postpetiole longitudinally and concentrically rugose-punctate, a median dorsal area somewhat smoother, lateral surfaces rugose. Gaster smooth and shining.

Pilosity moderate, hairs of medium length, suberect, acute, except on the dorsal surface of the thorax, where truncate.

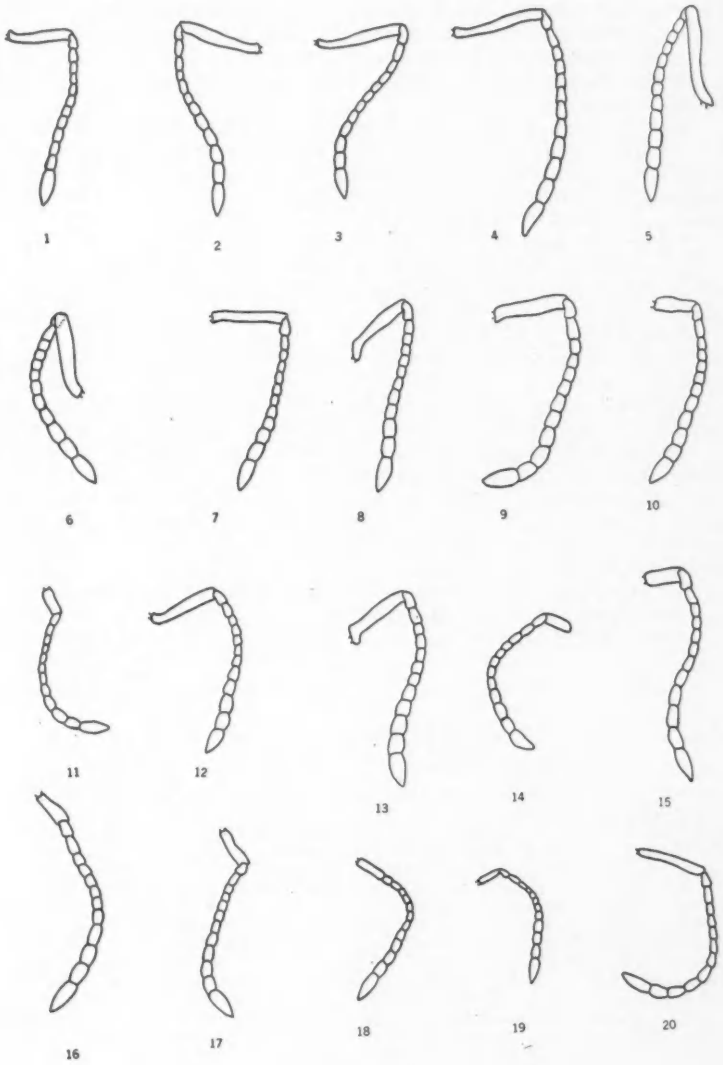
Color ferruginous, dorsal surface of the head and posterior surface of the 1st gasteric segment more brownish.

Worker (Arizona specimens): Length 3.9–6 mm.

EXPLANATION OF PLATE VI

Antennae of males of species of *Myrmica:*

Fig. 1. *Myrmica laevinodis* Nylander. Fig. 2. *Myrmica laevinodis* var. *bruesi* Wheeler. Fig. 3. *Myrmica smythiesi* subsp. *dshungarica* Ruzsky. Fig. 4. *Myrmica sulcinodis* Nylander. Fig. 5. *Myrmica sulcinodis* var. *sulcinodoscabrinodis* Forel. Fig. 6. *Myrmica scabrinodis* subsp. *mexicana* Wheeler. Fig. 7. *Myrmica lobicornis* Nylander. Fig. 8. *Myrmica lobicornis* subsp. *fracticornis* Emery. Fig. 9. *Myrmica sabuleti* subsp. *americana* Weber. Fig. 10. *Myrmica sabuleti* subsp. *hamulata* Weber. Fig. 11. *Myrmica sabuleti* subsp. *nearctica* Weber. Fig. 12. *Myrmica schencki* Emery. Fig. 13. *Myrmica schencki* subsp. *emeryana* Forel. Fig. 14. *Myrmica schencki* subsp. *tahoensis* Wheeler. Fig. 15. *Myrmica brevinodis* Emery. Fig. 16. *Myrmica brevinodis* subsp. *sulcinodoides* Emery. Fig. 17. *Myrmica brevinodis* subsp. *brevispinosa* Wheeler. Fig. 18. *Myrmica wheeleri* Weber. Fig. 19. *Myrmica punctiventris* subsp. *pinetorum* Wheeler. Fig. 20. *Myrmica punctiventris* Roger.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General characters of the cotype with the following variations: The lateral extensions of the lamina at the bend of the antennal scape may be practically absent; seen from above the epinotal spines may be distinctly shorter than the distance between their bases and may be blunt and subparallel; the anterior face of the petiole may be plane; the postpetiole may be twice as high as long with the anteriorly produced ventral lobe acutely angular.

The frontal area may be entirely striate, though clearly delimited; the sculpturing of the anterior part of the thorax may be deeply and irregularly reticulate; the sculpturing of the pedicel may be much feebler though conspicuously punctate and the rugosity of the postpetiole not distinctly concentric.

The pilosity may be comparatively abundant.

The color of the body ranges from ferruginous to a dark brown, almost black, with the appendages somewhat lighter but still quite dark brown.

Female: Length 4.7–6.4 mm.

Similar to the worker, with the usual sexual differences, including the following:

Epinotal spines distinctly shorter than the part of the epinotal declivity ventral to them, with blunt tips, and, from above, diverging.

Sculpture of the pronotum coarsely reticulate anteriorly, becoming rugose posteriorly and on the remainder of the sides; scutum of mesonotum anteriorly with a small smooth median area from which radiate scattered rounded vermiculations, postero-medially becoming more or less parallel rugosities; base of the sculpturing of the body, exclusive of the gaster, thickly punctate.

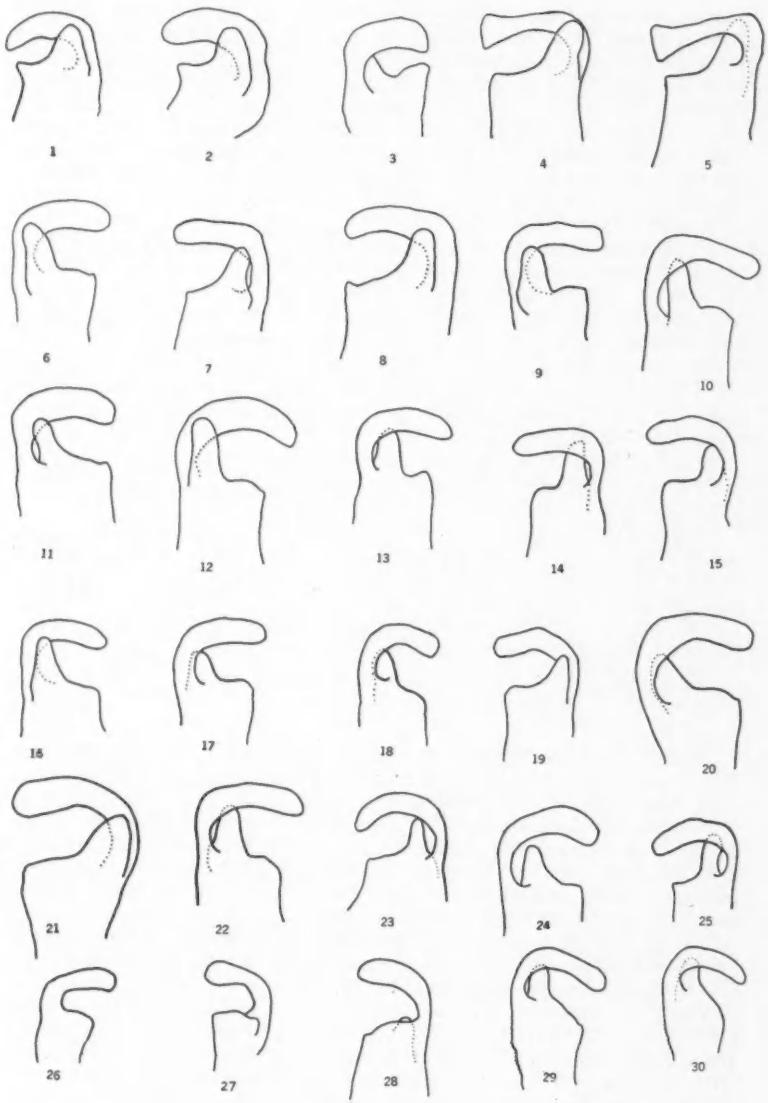
Color of body dark brown, appendages somewhat lighter. Wings hyaline, with a brownish cast; veins brown.

Male: Length 4.5–6.6 mm.

EXPLANATION OF PLATE VII

Volsellae of male genitalia of *Myrmica* species:

Fig. 1. *Myrmica laevinodis* Nylander. Fig. 2. *Myrmica laevinodis* var. *bruesi* Wheeler. Fig. 3. *Myrmica smythiesi* subsp. *dshungerica* Ruzsky. Fig. 4. *Myrmica sulcinodis* Nylander. Fig. 5. *Myrmica sulcinodis* var. *sulcinodo-scabrinodis* Forel. Fig. 6. *Myrmica scabrinodis* Nylander. Fig. 7. *Myrmica scabrinodis* subsp. *mexicana* Wheeler. Fig. 8. *Myrmica lobicornis* Nylander. Fig. 9. *Myrmica lobicornis* subsp. *fracticornis* Emery. Fig. 10. *Myrmica lobicornis* subsp. *fracticornis* Emery. Fig. 11. *Myrmica sabuleti* Meinert. Fig. 12. *Myrmica sabuleti* subsp. *americana* Weber. Fig. 13. *Myrmica sabuleti* subsp. *hamulata* Weber. Fig. 14. *Myrmica sabuleti* subsp. *hamulata* Weber. Fig. 15. *Myrmica sabuleti* subsp. *nearctica* Weber. Fig. 16. *Myrmica schencki* Emery. Fig. 17. *Myrmica schencki* subsp. *emeryana* Forel. Fig. 18. *Myrmica schencki* subsp. *emeryana* Forel. Fig. 19. *Myrmica schencki* subsp. *tahoensis* Wheeler. Fig. 20. *Myrmica brevinodis* Emery. Fig. 21. *Myrmica brevinodis* Emery subsp. *sulcinodoides* Emery. Fig. 22. *Myrmica brevinodis* subsp. *brevispinosa* Wheeler. Fig. 23. *Myrmica scabrinodis* subsp. *wesmaeli* Bondroit. Fig. 24. *Myrmica scabrinodis* (=*M. specoides* Bondroit). Fig. 25. *Myrmica scabrinodis* subsp. *rugulosoides* var. *striata* Finzi. Fig. 26. *Myrmica wheeleri* Weber. Fig. 27. *Myrmica wheeleri* Weber. Fig. 28. *Myrmica moravica* Soudek. Fig. 29. *Myrmica punctiventris* Roger. Fig. 30. *Myrmica punctiventris* subsp. *pinetorum* Wheeler.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Antennal club indistinctly 4-jointed; antennal scape equal in length to from 5–6 of the following funicular joints together; seen from a postero-dorsal view bent obtusely at the basal ⅓, 0.6 as wide at the somewhat compressed base as at the distal part; joints 1–2 of the funiculus together distinctly longer than joints 3–5 together. Epinotal declivity dorsally with two obtuse tubercles. Petiole in profile distinctly higher than the exposed ventral surface is long, with plane anterior face and evenly convex postero-dorsal surfaces. Postpetiole, in profile, 0.6 as long as high, elliptical. Gaster ovate, 19–30 teeth on the sagittae, averaging 24, volsellae of genitalia as illustrated. Legs moderately long and slender.

Surface of head shining, with sparse, irregular, somewhat fine rugae or vermiculations, densely punctate at the base of the sculpturing; thorax largely smooth and shining, striate at the margins of the segments and sparsely punctate laterally; petiole shining, finely punctate and with scattered striae; postpetiole and gaster smooth and shining.

Hairs of head short, fine, subappressed and numerous; of thorax short, fine and sparse; of pedicel and gaster fine and moderately abundant; of appendages numerous, fine and unappressed. Appressed pubescence on the legs.

Color of head black; of remainder of body and appendages blackish brown; apex of gaster, antennal club and tarsal joints brown. Wings hyaline with a brownish cast; veins brown.

There is an amazing range of variation in this subspecies over North America, but with completely intermediate conditions. This variation can not be decisively correlated with ecological conditions because of the absence of other than date and locality records for many of the specimens. In general, the darkest ants come from the mountains of the West and from eastern Canada.

Type Localities: Connecticut (Pergande); New York: Buffalo (Wasmann); "Dakota."

Other Localities:

NEWFOUNDLAND: Bay of Islands (Gratacap). NOVA SCOTIA: Pleasantfield (W. H. Prest); Penobsquis, Portaupique (C. A. Frost); Port Maitland (W. Reiff); Truro (no collector); Digby (J. Russell); Yarmouth (T. D. A. Cockerell). NEW BRUNSWICK: St. Andrews (R. O. M. Z.). QUEBEC: Chelsea, Hull, Kingsmere (W. M. Wheeler). ONTARIO: East Main R., border of Ungava, James Bay (A. Skinner); Gravenhurst, Muskoka Dist., Ottawa (no collectors); Pelee Isl. (M. Talbot); Franz (N. A. Weber); Lake Couchiching, Arnprior, Lampton, Toronto, Weston (R. O. M. Z.); Manitoulin I. (C. H. Kennedy). MAINE: Kittery Point (Pergande Coll.); Old Town, Presque Isle (M. W. Wing); Ocean Point (E. & G. Wheeler); Glenmere (W. M. Wheeler); Gardiner, Salsbury Cove, Mt. Desert I. (N. A. Weber). NEW HAMPSHIRE: Errol and Swift Diamond Farm, Coos Co. (H. Shapley); Franconia (Fiske); Mt. Washington Summit (C. S. Bacon, A. T. Slosson); Contoocook (E. & G. Wheeler). VERMONT: Woodstock (N. A. Weber). MASSACHUSETTS: Woods Hole (H. Bagg, T. D. A. Cockerell, W. M. Wheeler); New Boston, Berkshire Co. (W. M. Wheeler); Milton (C. H. Blake); Truro (A. P. Morse); Middlesex Falls, Stony Brook Res., Boston, S. Wellfleet

(N. A. Weber). CONNECTICUT: Colebrook, Litchfield Hills (W. M. Wheeler); New Haven (Type Locality, T. Pergande); East Wallingford (R. F. Snodgrass). NEW YORK: Pine Island, Niagara Falls, Ithaca (no collectors); Greenville, Mosholu, Branxville (W. M. Wheeler); Fishers Isl., Flatbush, L. I. (T. Pergande); Suffern (A. T. Gaul). NEW JERSEY: So. Orange, Fort Lee, Hoboken, Arlington (no collectors); Matawan (W. M. Miller); "New Jersey" (T. Pergande). PENNSYLVANIA: St. Vincent (Schmitt); Centre Co., Spring Creek, State Coll., Penn-Roosevelt Dam, Philadelphia (W. L. Brown). DISTRICT OF COLUMBIA: Washington (T. Pergande). MARYLAND: Bladensburg (T. Pergande). WEST VIRGINIA: Terra Alta, Preston Co. (G. C. Wheeler). TENNESSEE: Smoky Mts., (A. C. Cole); Chimney Peaks, Montvale Spgs. (C. H. Kennedy). SOUTH CAROLINA: Caesar's Head (M. R. Smith). OHIO: Columbus (M. R. Smith); North Bass and Sisters Isl. (M. Talbot); Put-in-Bay, Green Isl. (C. H. Kennedy); Southcentral Reg. (L. G. & R. G. Wesson); Killdeer Plain (M. E. Amstutz). INDIANA: Plymouth (M. R. Smith); Dune Acres (D. Lowrie); Lafayette (H. O. Deay). ILLINOIS: Rockford (W. M. Wheeler); Cook Co., Chicago (H. Brun); Momence (D. Lowrie). MICHIGAN: Warrens Dunes (M. Talbot); Ann Arbor (J. Dawson); Porcupine Mts. (O. M. McCreary). WISCONSIN: Madison (A. C. Burrill); Lake Geneva, Williams Bay (Ill. Nat. Hist. Surv.); Milwaukee (Cudahy); Calhoun (no collectors). IOWA: Ames (T. Pergande); Siuox City (C. N. Ainseli).

MINNESOTA: Brainerd, Bemidji (N. A. Weber); Duluth (R. E. Gregg). NORTH DAKOTA: Mikkelson (J. E. Goldsberry); Towner, Grassy Butte, Cannonball R., Dunseith, Anamoose, Upham, Langdon, Edmore, Stanley, Hope, Bismarck (N. A. Weber); Wildrose (no collector); Dickinson (C. N. Ainslie); Cass Co., Fabian, Fargo, Gardner (C. Schonberger); Divide Co. (J. Davis); Hettinger Co., Garrison (R. P. Uhlmann). SOUTH DAKOTA: Hill City (W. S. Creighton, Pergande Coll.); Spearfish, Kennebec (A. C. Cole.) NEBRASKA: North Platte (A. C. Cole). KANSAS: Richmond (E. G. Titus). MANITOBA: Turtle Mts., Audy L., Riding Mt. Nat. Park (N. A. Weber). SASKATCHEWAN: Saskatoon (K. M. King); Gainsborough (N. A. Weber). ALBERTA: Bilby, Edmonton (G. Salt); Banff (P. Darlington, G. Salt, W. M. Wheeler); Moraine Lake, Lake Louise (W. M. Wheeler); Vermillion Pass (E. Whymper). MONTANA: Browning (W. S. Creighton). WYOMING: Yellowstone Park (A. C. Cole); U. of Wyo. Camp., 9,600 feet (T. D. A. Cockerell). IDAHO: Twin Falls, Stanley (A. C. Cole); Double Springs, Lost River Range, Gibbons Pass, Bitteroot Mts., (W. S. Creighton). COLORADO: Florissant, Colorado Springs, Cripple Creek, 10,200 ft., Buena Vista, Cheyenne Canyon, Manitou (W. M. Wheeler); Ute Pass (T. D. A. Cockerell, W. M. Wheeler); Sugar Loaf Mt., Eldora, 8,600 ft., Pikes Peak (T. D. A. Cockerell); Creede Co., 8,844 feet (S. J. Hunter); Rocky Mts., Nat. Park, 9,000 and 9,500 feet (N. A. Weber); Boulder (W. S. Creighton, P. J. Schmitt); Hartsel, Fraser, Winfield, Gransby (W. S. Creighton). UTAH: Salt Lake Co. (R. V. Chamberlin, Grundmann, Fox); Blue Mts., Mirror L., Uinta Mts., 10,000 feet, La Sal Mts., Bryce Canyon (W. S. Creighton); Alta, Camas, Wales Summit Co.) (Grundmann, Rees); Neole, Duchesne Co. (Knowlton & Harmston). NEVADA: Contact (A. C. Cole). MEW MEXICO: Beulah,

8,000 feet (T. D. A. Cockerell); James Canyon, 8,000 feet; Cox Canyon, 9,300 feet; Cloudcroft, 8–9,000 feet; Sacramento Mts., (W. M. Wheeler); Harvey's Ranch, Las Vegas Mts., 10,000 feet (E. L. Hewett); Taos (A. C. Cole). ARIZONA: Coconino Forest, Grand Canyon, Mt. Lemmon, 8–9,100 feet, Stratton, 6–7,000 feet and Bear Wallow, 8,000 feet, Santa Catalina Mts., (W. M. Wheeler); Ramsey Canyon, Huachuca Mts., 9,000 feet (W. M. Mann); Jacob's Lake, Kaibab Forest, 9,000 feet (W. S. Creighton, N. A. Weber). ALASKA: Metlahtla (T. Kincaid). BRITISH COLUMBIA: Emerald Lake (W. M. Wheeler); Carbonate and Prairie Hills, Selkirk Mts. (J. C. Bradley). OREGON: Neskowen, Mt. Hood, 6,000 feet (A. C. Cole).

The winged castes appear frequently in huge, dense swarms from late June to October. The following records are in the collection: Ontario: Aug. 9–Oct.; Quebec: Aug. 31; New Hampshire: Aug.; Massachusetts: Sept. 4; Connecticut: July 21–Aug. 29; New York: Aug. 2–Sept. 8; New Jersey: Sept. 22; Pennsylvania: Oct. 10; District of Columbia: Sept. 18–Oct. 12; Virginia: Aug. 27; Ohio: Oct. 8; Illinois: July 13–Oct. 24; Iowa: Aug.; South Dakota: July–Sept. 23; North Dakota: Aug. 19–Oct. 5; Colorado: June 26–Aug. 18; Arizona: July 24; New Mexico: July 8–14; Arizona: July 12–27; Saskatchewan: July 15; Alberta: Aug. 19; Idaho: July 3–Aug. 25; Nevada: Aug. 18; Utah: Aug. 10–14; Oregon: July 12; British Columbia: Aug. 13.

The variety *lobifrons*, which was described by Pergande in 1900 as a variety of *sabuleti*, has been synonymized after the direct comparison of the paratype referred to by Dr. Wheeler (1917 b, p. 21) with the cotype of *fracticornis*. The original description is too incomplete to be of value. The paratype is darker than the cotype of *fracticornis*, which is considered typical, but not darker than another cotype. The antennal scape has the same transverse lamina at the joint, though somewhat smaller; the epinotal spines are similar. The sculpturing is the same.

The variety *glacialis*, which was described by Forel in 1904 as a variety of *scabrinodis*, has been synonymized after the direct comparison of a cotype with the cotype of *fracticornis*. This is also darker in color but otherwise practically indistinguishable, with the same type of antennal scape, epinotal spines, sculpturing and other characters. In his original description Forel admitted its resemblance to *fracticornis* but separated it because "tous les articles du funicule sont au moins aussi longs qu'epais." I find, however, that in the cotype the joints are longer than broad, although the 3rd to 6th are quite broad, as also in *fracticornis*.

This cotype of *fracticornis* is probably one of the specimens responsible for Emery's original description of the variety as "klein, dunkel gefarbt, Fühlerschaft gekinckt, an der Basis wenig compress, ohne oder mit einem kleinen, spitzen zahn."

The study of two cotypes of *detritinodis* and the comparison of them with cotypes of *fracticornis* and *emeryana* convinces me that they would be better considered as specimens transitional between the above mentioned forms. The antennal scape is very similar to the scape of *emeryana* in the possession of a high oblique keel along the anterior and medial side of the bend and its practical absence on the posterior side. The sculpturing, however, is that of *fracticornis*; the rugae of the medial

dorsal surface of the head are much more regular than that of ***emeryana***; the dorsal longitudinal smooth area of the postpetiole is similar to that in some ***fracticornis*** workers and quite different from the deeply rugose surface im ***emeryana***. While there are other workers resembling the cotypes of ***detritinodis*** to be found in colonies of the other forms it does not seem desirable to retain a separate name for these. They are, after all, only transitional between forms in a highly variable genus.

The following variations may be noted in the castes of this form:

Males with the antennal scape equal in length to the 7 following joints together.

A few dark brown workers from Terra Alta, West Virginia, have somewhat shorter antennal scapes and with the dorsal keel at the bend greatly reduced; the epinotal spines are acute and strongly diverging. The rugosity of the head is unusually regular; the sculpturing of the thorax and pedicel is remarkably open, being, on the anterior part of the thorax especially, irregularly reticulate and on the pedicel nearly absent; the base of the thoracic sculpturing is punctate, that of the pedicel faintly reticulate. The discovery of the winged castes may necessitate establishing these as a distinct form but I hesitate to describe new forms upon such limited material in this highly variable genus.

Transitions to M. sabuleti subsp. americana

Workers with a wide lamina along the posterior margin of the antennal scape approaching the condition in ***sabuleti*** are found, but uncommonly. Among winged specimens, apparently from the same swarm, from Ontario are females of this ***sabuleti*** type with typical ***fracticornis*** females and males.

Transitions to M. brevinodis subsp. brevispinosa

The antennal scape of workers and females, which have no keel on the dorsal part and only a slight indication of a keel on the compressed basal portion closely resemble the scapes of ***brevispinosa***. The epinotal spines, however, are of normal length. The most distinct of this form include a dark worker cotype of ***fracticornis*** from New Haven, Connecticut, three workers from Yellowstone Park, Wyoming, and three workers with a small ***fracticornis*** male from Mikkelson, North Dakota. It does not seem desirable to consider them a distinct form.

Anomalies

An abnormal male with fused antennal joints from Cheyenne Creek, near Colorado City, Colorado, was found with normal males; on the one antenna the distal two joints were fused, on the other the distal three joints were more or less completely fused. In a collection from Kennebec, South Dakota, occur males with distinct and acute epinotal spines and males with normal, obtuse tubercles. A worker from Calhoun, Wisconsin, has asymmetrical epinotal spines, the right spine being a little shorter than normal, the left spine being hardly longer than its base is wide.

BIOLOGY

This form frequently nests under stones or wood, occasionally under grass, especially in fairly damp situations. In the mountains of the West, according to Dr. Wheeler, it nests in rocky, warm slopes on openings among the pines. In North Dakota it is found in moister and more shaded localities than is *sabuleti americana*. The brood is kept in a series of chambers scattered through the top few inches of the soil, sometimes deeper. The workers of this subspecies are timid, some becoming temporarily immobile when disturbed. In digging up a colony at Towner, North Dakota, a new species of "velvet ant" or wasp of the family Myrmosidae, which I have described as *Myrmosa dakotensis* (Weber, 1934), was obtained which may have been parasitic on the ants. A colony from the same locality was taken to the island of Cuba and flourished in an observation nest in the much hotter and more humid climate until ended over a month later. The workers reared winged females from pupae of this colony on July 7, several weeks earlier than they have been taken in North Dakota.

In the Turtle Mountains of this state, several miles from the Canadian boundary, I found a colony of *fracticornis* nesting in close proximity to one of *Leptothorax acervorum canadensis* Prov.[1] The brood of the *Leptothorax* was in a curled-up leaf under debris on top of the soil and in several shallow chambers in the soil while the *Myrmica* brood was found in slightly deeper chambers a few centimeters away. The tangle of roots and the lateness of the day prevented careful examination of the nests but some tunnels of the two species were evidently very close to each other. The ants were removed and put in an observation nest where the two species took possession of separate cells though neither was aggressively hostile to the other. The *Leptothorax*, however, died within a few days. It is possible that the relations of the two species may be similar to those found by Dr. Wheeler between *M. brevinodis* and *L. emersoni* (Wheeler, 1903, 1907).

Myrmica lobicornis subsp. **jessensis** Forel

M. lobicornis var. *jessensis* Forel, Ann. Soc. Ent. Belg., 1901, *45:* 371, ☿.

Worker (after Forel):

Lobe of the antennae a little shorter than in the type, epinotal spines shorter and the petiolar node more rounded. Somewhat near the var. *schencki* Emery. Color deep as in *lobicornis* of the Alps and the North. Lobe of the antennae much more developed than in *fracticornis* Em. of the U. S.

Myrmica lobicornis var. **kieviensis** Karawajew

M. lobicornis var. *kieviensis*, Karawajew, Travaux syst. et faun., Ukrainian Acad. Sci., Kiev., 1934, p. 91, ☿.

A form from Kiev, Ukraine unknown to me.

Type Locality: Japan: Sapporo (Jesso Island).

[1]Near these was a nest of *Dolichoderus* (*Hypoclinea*) *plagiatus* subsp. *pustulatus* Mayr (det. Dr. W. M. Wheeler, *in litteris*), northernmost record of this genus in North America.

Myrmica lobicornis subsp. **lissahorensis** Starcke

M. lobicornis lobicornis var. *lissahorensis* Stärcke, Tijdschr. Ent., 1927, *70:* 79–80, ☿.

Lissa Hora (Besk.).

For a description of this form see the reference above.

Myrmica lobicornis subsp. **littoralis** Kuznetzov-Ugamskij

M. scabrinodis lobicornis var. *littoralis* Kuzenetzov-Ugamskij, "The Ants of the South Ussuri Region (In Russian)," 1928: 33–36, figs. 15–19, ☿ ♀ ♂.

Worker (after Kuznetzov-Ugamskij): Length 3.6–5.2 mm.

Antennal scape suddenly bent at the base and at the bend lightly striate longitudinally. Epinotal spines shorter than the horizontal surface of the epinotum, the space between them and strongly shining. Metasternal lobes blunt. Reddish brown, head and thorax darker.

Female (after Kuznetzov-Ugamskij): Length 5–5.7 mm.

Color of the body darker than in *M. scabrinodis lobicornis.*

Male (after Kuznetzov-Ugamskij): Length 5–5.4 mm.

Epinotum with two short, broad, pointed teeth (in the typical *lobicornis* they are blunt); the space between strongly shining, but not smooth, being microscopically sculptured. Pilosity somewhat abundant. Color of the body dark, leg joints, tarsi and distal half of the antennal funiculi reddish. (The antennal scape is equal in length to the 7 following segments according to Kuznetzov-Ugamskij's figure).

Type Localities: South Ussuri Region: Okeanskaja, Bassargin, Tigrovaja, Ussuri Station.

Myrmica lobicornis subsp. **lobulicornis** Nylander

M. lobicornis var. *lobulicornis* Nylander, Bull. Soc. Ent. France, 1856: LXXIX, ☿.

Worker (after Nylander):

In this subspecies the lobe at the base of the scape is smaller and less dilated than in the typical form of the species.

Type Locality: France: Mt. Dore.

Nylander described this subspecies from one worker and nothing more is known of its characteristics. Finzi (1926, p. 107) described a worker from England which he believes may possibly be ascribed to it.

Myrmica lobicornis subsp. **pyrenaea** Bondroit

M. arduennae var. *pyrenaea* Bondroit, Ann. Soc. Ent. Belg., 1918, *55:* 106, fig. 53, ☿.
M. lobicornis var. *pyrenaea,* Finzi, Boll. Soc. Adr. Nat., Trisete, 1926, *29:* 108, ☿; Santschi, Rev. Suisse Zool., 1931, *38:* 350, ☿.

For descriptions of this form see the references above.

Myrmica puerilis Stärcke

Myrmica puerilis Stärcke, Nederl. Ent. Ver., 12 Oct. 1942, p. XXVII, ☿ ♀ ♂.
M. scabrinodis var. *atlantica* Stärcke, *ibid.*
M. neglecta Stärcke, *ibid.*

A form from the Netherlands unknown to me.

Myrmica sabuleti Meinert

M. sabuleti Meinert, Kong. Danske. Vidensk. Selsk. Skrift., 1861, *5:* 327, ☿ ♂.
M. scabrinodis var. *bessarabica* Nassonov, Arb. Lab. Zool. Mus. Moscow Univ. (In Russian), 1889, *4:* 36, ☿.

Worker (after Donisthorpe): Long 2¼ lin.

Reddish yellow; gaster darker above. Antennal scape bent almost at right angles, base with a tooth, and on the upper side with a high sharp longitudinal keel. Frontal flaps large, ear-shaped. Frontal portion wholly or partly wrinkled. Sides of head irregularly, thorax and nodes of pedicel distinctly wrinkled longitudinally.

Female: Emery states that it is not possible to distinguish the ♂ and ♀ from those of *scabrinodis*.

Male (after Donisthorpe): Length 2½–2¾ lin.

Black; antennae for the great part, apex of gaster, joints of legs and feet yellow. Antennal scape a third of the length of the funiculus, the last joint longer than the two preceding ones together, often bent or divided in the middle. Antennae almost bare; legs with long, oblique, sub-erect hairs. First node of pedicel wrinkled longitudinally. Wing greyish brown to beyond middle.

Emery (1908, p. 177) believed that *sabuleti* might possibly be identical with the winged pair of ants described by Nylander as *M. granulinodis*.

Distribution: Europe, Central Asia.

Myrmica sabuleti subsp. **americana** Weber

M. sabuleti subsp. *americana* Weber, Lloydia (Lloyd Library, Cincinnati, Ohio), 1939, *2:* 144–146, ☿ ♀ ♂.
M. sabuleti of authors.
M. sabuleti subsp. *trullicornis* Buren, Iowa State Coll. Jour. Sci. *18:* 281–283, ☿ ♀.

Worker: Length 4.5–6.2 mm.

Antennal scape exceeding posterior margin of head by a distance equal to its distal diameter; seen from above, with nearly straight lower margin and slightly sigmoid upper margin, bent distinctly at the distal end, which is about one-third larger in diameter than the proximal end, equipped at the bend with a nearly vertical, high lamina which is prolonged a trifle along the sides; lamina, viewed posteriorly, in the form of an acute tooth; bend at right angles to the scape; joints 1 and 2 of the funiculus together distinctly longer than 3–5 together. Thorax, in profile, slightly convex, with distinct and rounded mesoëpinotal suture; epinotal spines, from the side, distinctly longer than the declivity ventral to them, projected upwards and backwards at about a 55° angle; seen from above, moderately diverging, about one-half longer than the distance between their bases. Petiole, in profile, with concave anterior face meeting the dorsal convex surface at a rounded angle, as long from apex of ventral tooth to postpetiole as it is high; postpetiole, in profile, with nearly plane ventral surface and convex dorsum, as high as long. Gaster ovate. Legs of moderate length.

Surface of head regularly and moderately sculptured; frontal area distinct, finely striate-punctate; clypeus with 10–14 rugae; median dorsal region with regular, comparatively close-set, rugae which diverge

to the posterior angles; posterior surface reticulate, lateral surfaces rugose-reticulate. Thorax coarsely and sharply rugose, slightly vermiculate dorsally. Petiole dorsally with deep, irregular, vermiculations, laterally deeply and more regularly rugose; postpetiole rugose, dorsally somewhat concentrically rugose. Surfaces of body, except gaster, punctate at the base of the sculpturing. Gaster smooth and shining.

Pilosity moderate, hairs coarse, truncate or acute; appendages with moderately coarse, subappressed hairs; no pubescence on legs.

Color of head brown, of thorax and appendages ferruginous, gaster dark brown, lighter apically.

Female: Length 5.2–7 mm.

Similar to the worker and with equally high keel on the antennal scape, which is prolonged slightly more on the posterior side.

Differing in the following: Epinotae, spines shorter than the declivity ventral to them, stout and bluntly tipped. Petiole, in profile, with faintly concave anterior face, slightly longer from apex of ventral tooth to postpetiole than it is high. Postpetiole with plane ventral and convex dorsal surface, distinctly higher than long.

Sculpturing of the head less regular. Pronotum at the sides deeply vermiculate-rugose, reticulate only at the very anterior margin; posterior sides of thorax evenly rugose; scutum of mesonotum with elongate anteromedian smooth area from which radiate fairly even rugosities, somewhat vermiculate on the sides. Pedicel deeply sculptured as in the worker.

Pilosity moderately abundant, partly truncate, partly acute; legs with appressed hairs but without pubescence.

Color of head ferruginous, brownish mid-dorsally; thorax ferruginous with two elongate parapsidal brown blotches on the mesonotum; remainder of body and appendages ferruginous, gaster with a brown transverse, medial band. Wings hyaline with a brownish cast; veins brown.

Male: Length 5.2–6.6 mm.

Antennal scape subcylindrical, somewhat larger in diameter distally, evenly bent at a slight angle at the basal ¼, equal in length to from 4–5 of the following segments together; funicular club indistinctly 4–5–jointed. Epinotal declivity armed dorsally with two distinct subacute or rounded tubercles. Petiole, in profile, with plane anterior face and convex dorsal surface; postpetiole, in profile, one-fourth higher than the petiole, dorsal surface convex, ventral surface nearly plane to slightly convex. Sagittae of the genitalia with 25–31 serrations; volsellae as illustrated.

Surface of head shining, with comparatively numerous rugae, punctate at the base of the sculpturing; thorax shining, abundantly rugose-striate except on the largely smooth scutum of the mesonotum, punctate at the base of the sculpturing; petiole thinly but distinctly rugose, finely punctate basally; postpetiole and gaster smooth and shining.

Pilosity moderately abundant, acute, fine. Appressed pubescence on the antennae and legs.

Color of head blackish brown, remainder of body and appendages dark brown, pedicel and base of gaster, antennal club and tarsi lighter brown. Wings hyaline with a brownish cast; veins brown.

Type Locality: Colebrook, Connecticut, Aug. 16, 24, 1904 (W. M. Wheeler).

Other Localities: QUEBEC: Hull, Kingsmere (W. M. Wheeler); Renfrew (M. Stewart). ONTARIO: Toronto (A. J. Crew, M. Sewell); Renfrew (M. Stewart); Ottawa (no collector); Pelee Is. (M. Talbot); Kingston (A. B. Klugh). MAINE: So. Harpswell, Casco Bay, Sebascodegan Is. (W. M. Wheeler); Kittery Point (Pergande Coll.); Old Town (M. W. Wing). NEW HAMPSHIRE: Mt. Washington (no collector); Durham (Fiske). MASSACHUSETTS: Woods Hole (N. Bagg, K. W. Cooper, A. H. Sturtevant, N. A. Weber); Cuttyhunk (Cockerell); Readville (J. H. E.); Forest Hills, Blue Hills (N. A. Weber, W. M. Wheeler); Newton, Falmouth (A. H. Sturtevant, K. W. Cooper, N. A. Weber); Wellesley (A. P. Morse); New Boston, Berkshire Co. (W. M. Wheeler); Lawrence (U. S. N. M.); Nantucket Is. (Pergande Coll.); Plum Is., Newbury (S. K. Harris); Yarmouth Port (H. Shapley). CONNECTICUT: Colebrook (W. M. Wheeler); New Haven (B. H. Walden); E. Wallingford (R. E. Snodgrass); Devon (N. A. Weber). RHODE ISLAND: E. Greenwich (N. A. Weber). NEW YORK: Carmel, North Castle, Ramapo, Greenville, Hollow, L. I., Ashokan Surv., Mosholu, Bronxville (W. M. Wheeler); Rochester (A. B. Klots); West Farms, New York City (J. Angus); Tuckahoe (no collector); Schenectady (C. F. Turner); Syracuse (E. & G. Wheeler); Fisher's Is., L. I. (U. S. N. M.); Staten I., Croton (A. T. Gaul). NEW JERSEY: Newfoundland (W. M. Wheeler); So. Orange, Fort Lee (no collector); Normandy B. (W. P. Horen); Watchung Mts. nr. Westfield (C. R. Mekeel, N. A. Weber); Caldwell, Camden Co. (U. S. N. M.). PENNSYLVANIA: Rockville, Philadelphia (W. L. Brown); Beatty (U. S. N. M.); Swarthmore Coll., Towanda (N. A. Weber). DISTRICT OF COLUMBIA: Washington (T. Pergande). VIRGINIA: Wallops I. (W. L. McAtee); "Eastern Shore" (U. S. N. M.). TENNESSEE: Cold Spring Mt. (C. A. Dennis). OHIO: North Bass I., So. Bass I. (M. Talbot); Southcentral Region (L. G. & R. G. Wesson); Kildeer Plain (M. E. Amstutz). MICHIGAN: Lansing (A. C. Cole); Mich. Biol. Sta., Flat Rock (M. Talbot). INDIANA: Tremont, Chesterton (R. E. Gregg); Plymouth (M. R. Smith); Lake Co. (Blatchley); Lafayette (H. O. Deay). ILLINOIS: Champaign (Hart, Weed, A. O. Weese); Billets Sta. (Forbes); Urbana (A. Duke, Hart, Hunt, Martin, McElfresh, Shaml, Terrill, Weed, J. Zetek); Bradford (Kelly); Beach (Frison, Knight, Ross); Cedar Lake, Normal, Galesburg, Centralia, Cuba, Chicago, Bloomington, Quincy (Ill. Nat. Hist. Surv.); Algonquin (W. A. Nason); Hickory Creek, Zion (M. Talbot); Rockford (W. M. Wheeler); Waukegan, La Salle, Momence (R. E. Gregg, D. Lowrie). WISCONSIN: Milwaukee (C. E. Brown); Reedsburg, Madison, Delaven (A. C. Burrill). IOWA: Sioux City (C. N. Ainslie); Ames (W. F. Buren, Pergande Coll.); Boone, Clinton, Keokuk, Jewell, Oak Grove St. Pk., Granite (W. F. Buren). MINNESOTA: North Branch (W. E. Hoffmann); Birchcliff, Lake St. Croix (A. Johnson, N. A. Weber); Park Rapids (N. A. Weber); Duluth (Freeman, Roine, Gregg); Saganaga L. (R. E. Gregg). MANITOBA: Wawanesa, Sidney (N. A. Weber); Auverne (N. Criddle). NORTH DAKOTA: Mikkelson (J. E. Goldsberry); Badlands near Grassy Butte, Stanton, Mercer, Towner, Denbigh, Sterling, Leeds, Rugby, Velva,

Devils Lake, Bismarck, Valley City, Hebron, Belden, Watford City, N. Roosevelt State Park, Kathryn, Pillsbury, Jct. St. Highways 46 and 1 (La Moure Co.) (N. A. Weber); Arvilla, Grand Forks (N. A. Weber, E. & G. Wheeler); Medora, Black and Sentinel Buttes, Killdeer Mts., Glen Ullin, (E. & G. Wheeler); Binford (M. A. Hetland); Coleharbor (H. S. Telford, J. A. Munro). SOUTH DAKOTA: Capa (H. C. Severin). NEBRASKA: "Nebraska" (Pergande Coll.). KANSAS: Topeka (E. G. Titus); Osage City (A. C. Burrill). MONTANA: Helena (W. M. Mann). COLORADO: Colorado Springs, Manitou, Ute Pass, Florissan (W. M. Wheeler); Hartsel, Winfield, Granby (W. S. Creighton); Ouray (U. S. N. M.); Boulder (H. Andrews, W. P. Cockerell, W. S. Creighton, W. M. Wheeler); Roan Mts. (Cockerell); Cebolla (N. A. Weber); White Rocks, Boulder, 5,300 feet (L. F. Byers). IDAHO: Koscow (J. M. Aldrich). UTAH: Park City (U. S. N. M.); Bryce Canyon, Zion Canyon (N A. Weber). NEW MEXICO: Pecos (Cockerell).

The winged castes appear from July to October (Massachusetts: Sept. 24; Connecticut: Aug. 14–24; Illinois: July 13–Oct. 24; Pennsylvania: Oct. 12; North Dakota: Aug. 16–Sept. 11; Colorado: July 9–Aug. 10; Utah: July 26; Arizona: July 28). From a single swarm of winged ants in North Dakota I took both sexes of ***americana***, a female of ***M. brevinodis*** subsp. ***brevispinosa*** and both sexes of ***Lasius niger*** subspecies.

Many workers of this subspecies and ***fracticornis*** Emery can not be separated satisfactorily without the additional evidence of the males. The higher keel or lamina of the scape and its prolongation distally, with the comparatively flat ventral surface of the postpetiole, readily separates most of the ***americana*** workers from the corresponding slight transverse keel and convex ventral postpetiolar surface in worker ***fracticornis***; there are specimens, however, which combine a high keel on the scape with a distinctly convex postpetiole, or a slight keel with a nearly flat ventral surface of the postpetiole. These may be considered transitional in the absence of the males and a possible instance of hybridization.

The worker is readily separated from the worker of the subspecies ***nearctica*** by the short posterior extension of the keel on the scape and the higher and thinner transverse portion; the ventral surface of the postpetiole is also nearly plane instead of distinctly convex. The males can be readily separated from those of ***nearctica*** by the longer antennal scape and distinct epinotal tubercles.

BIOLOGY

This subspecies on the whole, is larger, paler and an inhabitant of warmer and dryer situations than either of the subspecies ***nearctica*** or ***fracticornis***.

The nests of ***americana*** are found under logs or stones and frequently in open situations under grass. The sites are commonly in sunny, dry localities. In North Dakota I have frequently found nests on the open prairie with the nest opening protected by a rather compact collar or slight mound of small pieces of dried plants, such as grass. This collar must protect the opening from being filled by wind-blown sand. Karawajew, at Kiev, U. S. S. R., observed colonies of ***M. rugulosa*** subsp.

constricta surrounding the nest opening with a similar collar of grass stems. In the valley of the Missouri River in North Dakota, the nests may be found under sandstone slabs on exposed slopes. An unusual nesting site in North Dakota was under an abandoned horse collar on the prairie, illustrating the frequently observed habit of ants in this region of protecting the nest opening. This may tend to hide the nest from predators or to reduce the extremely high moisture evaporation rate from the nest.

A prairie colony with worker brood was taken from North Dakota to the Island of Cuba and kept for over a month at the height of summer with entire success. Many workers were reared in a much hotter and more humid climate than the colony would encounter in North Dakota.

Predators of this subspecies observed at Towner, North Dakota, include the catbird, *Dumetella carolinensis* (L.), feeding on the workers, and thatching ants, *Formica rufa obscuripes* Forel, carrying dead males into their nest (Weber, 1935). The horned lizard, *Phrynosoma brevirostre* (Girard) from Grassy Butte, N. D., fed on *americana* workers at Towner.

Other ants inhabiting the same ecological formation at Towner include *Monomorium minutum minimum* Buckley; *Polyergus rufescens breviceps* Em. with its slave, *Formica fusca subsericea* Say.; *Formica sanguinea aserva* Forel with its slave, *F. fusca subsericea*; and *F. neogagates* Em.

This form is economically somewhat important. I have before me workers which were taken in Illinois attending corn root aphids and others which were reported attending aerial corn "lice." Still others from Illinois were found eating grains of a fallen corn ear and in the vial which was sent to me are several grains with the embryo and a large part of the starch inside the seed coat eaten away. Another collection from Illinois is of workers which were reported as "eating apple fruit." A number of Illinois collections are variously listed as "from volunteer wheat," "from timothy meadow," "in wheat field," "from English Elm," "from corn field," and "attacking sprouting corn." One Illinois record is of the workers eating a carabid larva. In North Dakota I have frequently taken them on the dry short-grass prairie where other insects must be the usual food. In Massachusetts workers of a populous colony on the margin of a road in woods were seen to bring to the inconspicuous nest opening under a bunch of grass a number of insects within a short time. The workers dragged two live beetle larvae and a live *Lasius niger americanus* worker to the nest. Two dealated *Myrmica americana* females with the worker size gasters wandered aimlessly about the opening; the time of year was late May so they must have wintered in the nest, as must have also two additional females dug up with the colony.

ANOMALY

The dealated *Myrmica* queen described and illustrated by Creighton (1928) belongs to this subspecies. "The thorax is joined directly to the gaster, the two petiolar joints having fused with the anterior face of the first gastric segment."

Myrmica sabuleti subsp. **hamulata** Weber

M. sabuleti Meinert ssp. *hamulata* Weber, Lloydia (Lloyd Library, Cincinnati, Ohio), *2:* 146–148, ♀ ♂.

Worker: Length 3.9–5.2 mm.

Antennal scape, from above, extending barely to the occipital margins, with feebly sigmoid anterior and more sigmoid posterior margin, produced in a distinct bend outwardly at the distal end and inwardly, or medially, at the proximal end; this end with a conspicuous high, thin, lamina extending completely around it and produced proximally in an acute hook; seen from above with a right-angled proximal bend from which the lamina projects medially as a large, acute tooth; antennal club quite distinctly 3-jointed, last segment nearly as long as the two preceding together. Thorax, in profile, convex, with a shallow, obtuse mesoepinotal suture; epinotal spines, in profile, extending upwards and backwards at a 45 degree angle, longer than the declivity ventral to them, slender, acutely pointed; from above, moderately diverging, about 1⅔ longer than the distance between their bases. Petiole, in profile, with anterior face barely concave, meeting the dorsal surface at about a 100 degree rounded angle, a little higher than the distance between the apex of the ventral tooth and the postpetiole; postpetiole, in profile, with convex dorsal and ventral surfaces, about two-thirds as long as high. Gaster ovate. Legs of moderate length.

Surface of the head rather deeply sculptured, several mid-dorsal rugae bounded by vermiculations, becoming reticulate on the sides and posterior surface. Surface of the thorax deeply vermiculate longitudinally, sides more rugose. Petiole deeply vermiculate; postpetiole more rugose, with a narrow mid-dorsal longitudinal band of fused rugae. Gaster smooth and shining. Base of the sculpturing not distinctly punctate.

Pilosity moderately abundant, dorsal hairs mostly truncate; subappressed hairs on the legs; no pubescence.

Color of body dark brown with head and gaster nearly black; appendages brown; hairs bright yellow.

Female: Length 4.9–5.7 mm.

Similar to the worker, with the following differences: Lamina of the antennal scape more erected medially and the hook projected somewhat downward. Epinotal spines shorter than the declivity ventral to them, bluntly tipped. Anteromedian triangular area of the scutum of the mesonotum smooth and shining, from which extend several rugae posteriorly and a moderate number of lateral rounded vermiculations.

Color largely dark brown dorsally and more ferruginous on the sides and appendages. Wings hyaline; veins pale brown.

Male: Length 4.2–5 mm.

Antennal scape equal in length to from 2–3 of the following joints together, bent at the basal ⅓ and incrassate immediately distal to the bend; funicular club indistinctly 5-jointed. Epinotal declivity with two distinct dorsal tubercles. Petiole, in profile, with dorsal surface convex, as long from apex of the slight ventral tooth to postpetiole as it is high; postpetiole nearly 1½ times as high as long, dorsally and ventrally convex. Sagittae of the genitalia with 19–22 serrations, volsellae as illustrated.

Sculpturing of head sparsely and feebly rugose, densely punctate. Dorsal surface of thorax shining, sparsely and feebly rugose, sides more coarsely rugose and punctate. Petiole punctate, with a few feeble rugae; postpetiole and gaster smooth and shining.

Pilosity moderately abundant, acute and fine, subappressed on the appendages.

Color moderately dark brown, head and gaster somewhat darker; wings hyaline, veins pale brown.

Described from a colony of all castes taken by Dr. W. M. Wheeler at Hayne's Canyon, 8,000 feet, Sacramento Mts., New Mexico, July 3, 1917.

This extreme form of ***sabuleti*** may be separated readily from the subspecies ***nearctica*** and ***americana*** by the shorter antennal scape in the male and, in the workers and females, by the unusual prolongation of the lamina of the scape into a hook on the posterior surface.

Myrmica sabuleti subsp. **lonae** Finzi

M. scabrinodis subsp. *lonae* Finzi, Boll. Sc. Adr. Sc. Nat., Trieste, 1926, *29:* 103–104, fig. 11, ♀ ♂.
M. scabrinodis var. *lonae* Karawajew, Mem. Acad. Sc. Ukraine, 1929, *13:* 207–208.
M. sabuleti st. *lonae*, Santschi, Rev. Suisse Zool., 1931, *38:* 346–347.

For descriptions of this form see the references above. Judging from a worker sent me it seems to be a ***sabuleti*** form with an exaggerated development of the keel on the antennal scape.

Myrmica sabuleti subsp. **nearctica** Weber

M. sabuleti ssp. *nearctica* Weber, Lloydia (Lloyd Library, Cincinnati, Ohio), 1939, *2:* 148–149, ♀ ♂.

Worker: Length 3.4–4.4 mm.

Frontal carina comparatively large, auriculate and erect. Antennal scapes barely exceeding posterior margin of head; seen from above, straight, subcylindrical, bent slightly outwards distally; with a thickened, subopaque lamina extending the entire distance around the bend and along the posterior margin fully a third the length of the scape, the lamina slightly raised at the bend but horizontal along the posterior margin and even with the top of the scape, the scape at the bend thickened in diameter and slightly produced at the posterior side; scape, from a posterior view, much thickened at the bend, which is nearly right-angled, narrow and compressed distal to the bend, normally shaped at the distal ⅔; joints 1 and 2 of the funiculus together about one-fifth shorter than joints 3–5 together. Thorax, in profile, convex, evenly and distinctly impressed at the mesoëpinotal suture; epinotal spines, in profile, slender, acute, with apices upturned, directed upwards and backwards at a 55–65 degree angle, a little shorter than the declivity ventral to them; from above, slightly longer than the distance between their bases, widely diverging. Petiole, in profile, with slightly concave anterior face meeting the nearly flat dorsal surface at a rounded right angle, about as long from apex of ventral tooth to postpetiole as it is high; postpetiole, in profile, with distinctly convex ventral surface, produced anteriorly, and convex dorsal surface produced posteriorly;

nearly twice as high as long. Gaster ovate. Legs moderately long and slender.

Surface of head largely reticulate-vermiculate, with few longitudinal rugae on the mid-dorsal surface; frontal area distinct, smooth and shining except for sparse punctures. Dorsal surface of thorax coarsely reticulate-vermiculate, mostly reticulate, sides coarsely rugose, vermiculate anteriorly. Petiole moderately vermiculate dorsally, more regularly rugose laterally; postpetiole shallowly rugose, smooth and shining on a mid-dorsal longitudinal area. Base of sculpturing on body, except on gaster, abundantly punctate. Gaster smooth and shining.

Pilosity moderate, comparatively fine, hairs truncate or acute; legs with subappressed hairs; no pubescence.

Color of head from ferruginous to dark brown, thorax also variable but lighter, gaster dark brown, appendages ferruginous to brown.

Female: Length 5–5.7 mm.

Similar to the worker, with the following differences: Antennal lamina, especially at the bend, somewhat raised. Epinotal spines a little shorter and blunter, pointed downwards slightly.

Sculpture of head more regularly rugose. Sides of thorax rugose, anterior margin of pronotum vermiculate-reticulate; scutum of mesonotum with an anterior triangular smooth area, posteriorly followed by several rugae and, laterally, by rounded, open vermiculations. Pedicel deeply rugose, more vermiculate dorsally.

Pilosity moderately abundant, finer and subappressed on the gaster; subappressed hairs on the legs; no pubescence.

Color of head ferruginous, infuscated dorsally; thorax lighter ferruginous, mesonotum with distinct anteromedian and parapsidal brown blotches, several median blotches on the sides; pedicel and appendages light ferruginous; gaster dark brown, wings hyaline; veins light brown.

Male: Length 4.3–4.7 mm.

Antennal scape subcylindrical, slightly incrassate towards the middle, 2½ times as long as wide, shorter than the 3 following segments of the funiculus together; antennal club 4-jointed; epinotal declivity armed dorsally with two low and indistinct tubercles. Petiole a little longer from apex of ventral tooth to postpetiole than it is high, evenly convex above; postpetiole 1½ times as high as long, convex dorsally, less convex ventrally, slightly higher than the petiole. Sagittae of the genitalia with 21–24 teeth; volsellae as illustrated. Gaster ovate. Legs moderately long and slender.

Surface of head somewhat shining, thickly punctate, with sparse, low, rugae. Scutum of mesonotum mostly smooth and shining; sides thickly punctate, margins sparsely rugose; petiole finely punctate; postpetiole and gaster smooth and shining.

Pilosity moderate, erect, coarse, and truncate on the head, thorax and appendages, otherwise largely fine and acute; no pubescence.

Color brown, dark brown on the head. Wings hyaline; veins whitish to brown.

Described from colonies taken by myself 14 miles southwest of Towner, North Dakota, June 5, 1932 (type colony and locality) and at Wawanesa, Manitoba, July 2, 1933. Syntype colonies were taken by

W. M. Wheeler at Cheyenne Canyon and Buena Vista, Colorado. My colonies were both in the woods along the Souris or Mouse River, which drains eventually to Hudson's Bay. The North Dakota colony was discovered on the north and cold slope of a densely wooded ravine (*Populus tremuloides* Michx.) and the nest was in the form of anastomosing chambers under moss. Sept. 5, 1937, the exact site of the Dakota collection was revisited and a small colony was found. The same type of nest was present and the workers became temporarily immobile ("feigned death") when disturbed. Other colonies were found 5 miles north and 6 miles south of Towner. All nests were in wooded areas and the colonies were small.

This subspecies closely resembles the European form; it can be distinguished readily from *americana* by the shorter male antennal scape and the greater development of the lamina on the worker scape.

Other localities: NORTH DAKOTA: Mikkelson (J. E. Goldsberry); Arvilla, Killdeer Mts. (N. A. Weber, E. & G. Wheeler); Grand Forks (L. Monda, N. A. Weber); Grafton, Breien, junction of Cannonball and Missouri Rivers (N. A. Weber). MICHIGAN: Marquette (O. G. Libby), ♂♂ and ♀♀ Aug. 22.

Myrmica sabuleti var. **pilosiscapus** Bondroit

M. pilosiscapus Bondroit, Ann. Soc. Ent. France, 1919: 301, ☿ ♀ ♂.
M. scabrinodis var. *pilosiscapus* Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 102, fig. 10; Santschi, Rev. Suisse Zool., 1931, *38:* 343.

Localities: Doubs, Arosa, ca. 1,900 m. and Graubunden (Finzi).
For descriptions of this form see the references above.

Myrmica sabuleti subsp. **scabrinodo-lobicornis** Forel

M. rubra var. *scabrinodo-lobicornis* Forel, Fourmis Suisse, 1874: 77, ☿.
M. sabuleti st. *lonae* var. *scabrinodo-lobicornis* Santschi, Rev. Suisse Zool., 1931, *38:* 347.

This form, which Forel erected as a transition between *scabrinodis* and *lobicornis*, I place here following Santschi who states that he has a good series of it.

Myrmica sabuleti var. **spinosior** Santschi

M. sabuleti var. *spinosior* Santschi, Rev. Suisse Zool., 1931, *38:* 346, ☿ ♀ ♂.

Type Localities: Eastern Pyrenees; Irun; Corse, Poggiolo; Spain; Italy. Type ♂ from Castelnovo, Venetia.

For a description of this form see the reference above.

Myrmica schencki Emery

M. scabrinodis schencki Emery, Zool. Jahrb. Syst., 1895, *8:* 315, ☿ ♀ ♂.
M. schencki Finzi, Boll. Soc. Adr. Sc. Nat., 1926, *29:* 109–111, fig. 14; Santschi, Rev. Suisse Zool., 1931, *38:* 351.

Worker (after Emery, 1908): Length 4–5 mm.

Dark colored, brownish red, head and gaster brown to blackish brown. Sculpturing strong, somewhat as *scabrinodis scabrinodis*, on

the postpetiole finer and weaker. Scape at the bend with a strong, broad transverse lobe, similar in that to ***lobicornis***, from the latter form differing in the shape of the petiole, whose node, in profile has not anterodorsally such a clear angle; in this condition ***schencki*** is intermediate between ***scabrinodis*** and ***lobicornis***. Epinotal spines long as in ***scabrinodis***, the infraspinal surface as a rule smooth.

Female (after Emery, 1908): Length 5–6 mm.

Differing from ***scabrinodis*** and ***lobicornis*** in the same manner as the worker.

Male (after Emery):

Specimens, which have not been found with workers or females, cannot be distinguished from ***scabrinodis scabrinodis***.

Distribution: Middle Europe to Manchuria and China.

Myrmica schencki var. **brunescens** Karawajew

M. schencki var. *brunescens* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 208, ☿.
M. lobicornis var. *brunescens* Santschi, Rev. Suisse Zool., 1931, *38:* 350–351, ☿.

Worker (after Karawajew):

Head thicker and with finer longitudinal sculpturing than in the type, with sharper ventral sculpturing and therefore little shining. Thorax irregularly and less deeply longitudinally wrinkled, especially at the sides. Pedicel more coarsely and irregularly, especially on the petiolar node, rugose longitudinally.

Head and gaster very dark brown, thorax, pedicel and appendages reddish.

Type Locality: North slope of the Caucasus: Teberda, Karatschai-Kreis, 20–25.VII.1927 (Karawajew).

Myrmica schencki subsp. **burtshak-abramovitschi** Karawajew

M. schencki var. *burtshak-abramovitschi* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 209, fig. 4, ☿.
M. lobicornis st. *burtshak-abramovitschi* Santschi, Rev. Suisse Zool., 1931, *38:* 351, ☿.

Worker (after Karawajew): Length 3.5–4.5 mm.

Head and frons as in the type, yet the lobe of the scape is extraordinarily strongly developed, the basal part of the scape also being very massive. The top of the scape at the bend is, in surface view, biscuit-shaped, even, from which the outer part of the lobe is broadly rounded. Epinotal spines long and thin, at the base, however, somewhat thick. The petiole is very short and the anterior edge projects as in ***lobicornis***.

The middle of the head is sharply but not deeply sculptured longitudinally, not thickly so that in the posterior section of the frons about 10–15 ridges are present.

Frontal area finely striate but not shining. Thorax very coarsely rugose longitudinally, about 4 rugosities dorsally; the postpetiole is hardly less coarsely sculptured than the petiole.

Very dark brown colored, the gaster (at the apex?) reddish yellow.

"Because of the constriction of the frons I place this variety with ***schencki*** and not with ***lobicornis***. As well as I can judge from Finzi's description this variety comes nearest to var. ***obscura*** Finzi."

Type Localities: Region of the "Wilden Sees" (Dikoje Osero), Korostenj-Distr., Wolhynien, 28.VII.1927 (N. Burtshak-Abramovitsch).

"Nest under a piece of Oligocene sandstone. The region is mountainous, forested and with dense *azalea pontica* vegetation."

Myrmica schencki var. **caucasicola** Arnoldi

M. schencki nat. *caucasicola* Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 172, ♀ ♂.

A form from the Caucasus in Asia unknown to me.

Myrmica schencki subsp. **emeryana** Forel

M. scabrinodis schencki var. *emeryana* Forel, Deutsche Ent. Zeitschr., 1914: 617, ♀.
M. scabrinodis schencki var. *monticola* Wheeler, Proc. Amer. Acad. Arts. Sc., 1917, *52:* 505–506, ♀ ♂.
M. schencki subsp. *latifrons* Stärcke, Tijdschr. Ent., 1927, *70:* 84, ♀.
M. schencki of authors.

The following descriptions are drawn from two worker cotypes and from the castes of a single colony from Rockford, Illinois.

Worker (Cotypes). Length 4.5–4.7 mm.

Antennal scapes exceeding posterior margin of head by a distance about equal to their distal diameter; seen from above, in the form of a drawn-out sigmoid curve with the distal end bent outwards and the proximal end, with the lamina, appearing nearly straight; distal diameter nearly twice that of the proximal end; seen from behind it is similarly curved, with the proximal part flaring out into a triangular end and attached at the lowest angle; with a conspicuous lamina, which seen from behind, projects as an apron from the medial side and the dorsomedial angle, being rounded into the dorsal surface; seen from above the lamina is produced over the end of the scape and along the anterior, but not the posterior, side. Thorax, in profile, evenly convex to the deep and obtuse mesoepinotal suture; epinotal spines, in profile, about as long as the declivity ventral to them, directed upwards at an angle of about 45 degrees backwards, acute and with the points upturned; from above, about 1½ times as long as the distance between their bases, diverging. Petiole, in profile, with distinctly concave anterior face forming a right angle with the slightly convex dorsal surface, one-half as long from apex of ventral tooth to postpetiole as high; postpetiole two-thirds as long as high, dorsal surface convex, ventral surface asymmetrically convex, being produced anteriorly. Gaster ovate. Legs of moderate length.

Surface of head rather coarsely sculptured; several irregular rugosities on the dorsal median surface, laterally and posteriorly becoming vermiculate-reticulate, frontal area clearly indicated but completely striate. Dorsal surface of the thorax deeply and longitudinally vermiculate, sides more regularly, but deeply rugose. Petiole deeply and irregularly vermiculate; postpetiole deeply and longitudinally rugose, somewhat fused mid-dorsally. Base of the sculpturing punctate, especially on the head and pedicel. Gaster shining, faintly reticulate.

Hairs moderately abundant and coarse, mostly truncate. Hairs of the appendages more numerous, subappressed.

Color of head dark ferruginous with a brown dorsal blotch; thorax and pedicel ferruginous, appendages lighter; gaster dark brown with lighter apex.

Worker (Illinois Specimens). Length 3.9–5.2 mm.

The lamina on the scape of some is reduced to a lower keel; joints 1 and 2 of the funiculus together are distictly longer than joints 3–5 together. The epinotal spines may be slightly shorter than the declivity ventral to them, though longer than those of *fracticornis* and distinctly upturned. The median dorsal surface of the head in some is more regularly rugose, though in a narrower area than in *fracticornis*. Hairs of the body may be mostly acute.

Female: Length 5.1–6.3 mm.

Similar to the worker with the usual sexual differences, including the following: Epinotal spines shorter and stouter, in some not curved upwards at the tips. Sides of the pronotum deeply reticulate, sides posteriorly more regularly rugose; antero-median triangular area of the mesonotum smooth and shining, from which radiate posteriorly 4–6 rounded rugae and, laterally, rounded and open vermiculations. Pedicel deeply sculptured, dorsal surface of the postpetiole somewhat concentrically rugose.

Hairs more numerous and acute.

Color of head brown; of thorax ferruginous with a median and parapsidal brown blotches on the mesonotum; a similar blotch on the mesothoracic episternite; gaster brown with lighter base; appendages ferruginous. Wings hyaline with a brownish cast; veins brown.

Male: Length 4.6–5.6 mm.

Antennal scape subcylindrical, slightly bent at the base, one-third as wide as long, equal in length to the following 3 segments together; club of funiculus indistinctly 4-jointed. Epinotal declivity armed dorsally with two slight, obtuse tubercles. Volsellae of genitalia as illustrated; sagittae with 21–25 serrations.

Surface of head shining, densely punctate, feebly rugose-reticulate; thorax shining, nearly completely, though feebly, striate, punctate at the base of the striae; petiole strongly striate, shining, very feebly punctate; postpetiole and gaster smooth and shining.

Hairs moderately abundant, fine, acute.

Color of head black or dark brown, remainder of body dark brown, the pedicel, appendages and tip of gaster paler. Wings hyaline with a brownish cast; veins brown.

Type Localities: Not specified but probably including North Carolina which is mentioned in the original description. Washington, D. C., specimens in the Wheeler collection were labelled cotypes.

Other localities: NEWFOUNDLAND: Bay of Islands (no collector). NOVA SCOTIA: Portaupique, Penobsquis (C. R. Frost); Pleasantfield, North Brookfield (W. H. Prest). MAINE: Casco Bay (W. M. Wheeler); Old Town, Ash Point (M. W. Wing); Monmouth (C. A. Frost); Ocean Pt. (E. & G. Wheeler); Cadillac Mt. top, Mt. Desert I. (J. C. & N. A. Weber). NEW HAMPSHIRE: Mt. Washington (U. S. N. M.); Mt. Monadnock, Mt. Kearsarge, Contoocook (E. & G. Wheeler); Union, Intervale (N. A. Weber). MASSACHUSETTS: Ellisville, Penekese I., Boston (W. M. Wheeler); Forest Hills, Blue Hills (N. A. Weber, G. C.

Wheeler, W. M. Wheeler); Concord, Petersham, Marblehead, Falmouth (N. A. Weber). CONNECTICUT: Colebrook (W. M. Wheeler). ONTARIO: Middle Is., E. & W. Sister Is., Pelee Is. (M. Talbot); West Bay, Manitoulin (C. H. Kennedy); Macdiarmid, Brent, Toronto, (R. O. M. Z.); L. Temagami (A. T. Gaul); Grimsby, Ottawa (no collectors); Renfrew (M. Stewart). NEW YORK: Richf. Spr., Ithaca (U. S. N. M.); Hartsdale (A. T. Gaul); Staten Is., Tuckahoe (no collectors). NEW JERSEY: Matawan, Lakehurst, Halifax (W. M. Wheeler); Morgan (Weiss); Caldwell (U. S. N. M.); Lower Mills (W. L. Brown); Watchung Mts. near Westfield (C. R. Mekeel, N. A. Weber). MARYLAND: Charlton H. (Pergande Coll.); Silver Springs (W. L. Brown). DISTRICT OF COLUMBIA: Washington (Pergande Coll. P.); "Washington" (Forel's cotypes).

VIRGINIA: Warm Springs (U. S. N. M.); "Virginia" (Pergande); Skyline Dr., 3360 ft., Shenandoah Mt. Park (N. A. Weber). NORTH CAROLINA: L. Toxaway (no collector); Mt. Mitchell, 3,400 feet (A. Forel). GEORGIA: Clayton, 2–3,700 feet (W. T. Davis). PENNSYLVANIA: St. Vincent (P. J. Schmitt); Ridley Twp,. Delaware Co. (N. A. Weber); State College, Centre Co. (The Rock), Philadelphia (W. L. Brown); White Haven (Bradley). MISSISSIPPI: Rara-Avis (M. R. Smith). OHIO: E. Sister I., Holland, Willard, Marblehead (M. Talbot); Southcentral Region (L. G. & R. G. Wesson). INDIANA: Miller, Valparaiso, Ogden Dunes, Smith (M. Talbot); Chesterton (R. E. Gregg); Ogden Dunes, Dune Acres (D. Lowrie); Lafayette (H. O. Deay). ILLINOIS: Champaign (Hart); Havana (Hart & Brown); Urbana (Hart, Farrar); Billets Sta. (Forbes); Peoria L. (Pergande Coll.); Galena, Freeport, Apple R., Can. State Park (Ross & Townsend); White Heath (H. H. Ross); Charlestown (Ross & Mohr); Marshall (Peppoon & Mohr); Oakwood (T. H. Frison); Hickory Creek, Palos Park (M. Talbot); Rockford (W. M. Wheeler). MICHIGAN: Warrens Dunes, Flat Rock (M. Talbot, C. H. Kennedy). IOWA: Spirit L., Boone, Clinton, Sabula, Inwood (W. F. Buren); Ames (W. F. Buren, T. Pergande).

WISCONSIN: Madison (A. C. Burrill); White Fish Bay (W. M. Wheeler); Superior, Foxboro (R. E. Gregg). MANITOBA: Treesbank (C. G. Hewitt); The Pas (R. H. Daggy). MINNESOTA: North Branch (W. E. Hoffmann); Itasca Park (E. & G. Wheeler); Red L. (Beltrami Co.), Shell L. (Becker Co.), Big Sand L. (Hubbard Co.) (N. A. Weber); Birchcliff, Lake St. Croix (A. Johnson, N. A. Weber); Duluth (Freeman, Roine, Gregg); Rice L., Holyoke, Knife R., Saganaga L. (R. E. Gregg). NORTH DAKOTA: Mikkelson (J. E. Goldsberry); Kelly, Turtle Mts., Bicycle, Arvilla, (E. & G. Wheeler); Towner, Bismarck, Sioux Co. nr. Breien, Kildeer Mts. (N. A. Weber); Cass Co. (C. Schonberger); Inkster, Manvel (C. V. Johnson). SOUTH DAKOTA: Hill City (Pergande Coll., N. A. Weber); Deadwood, 5,000 feet (E. & G. Wheeler). KANSAS: "Kansas" (G. F. Gaumer). WYOMING: Devils Tower (W. S. Creighton). COLORADO: Rocky Mt. Nat. Park; Glacier Basin Camp. (N. A. Weber); Custer Co. (T. D. A. Cockerell); Granby (W. S. Creighton); "Colorado" (U. S. N. M.); Manitou, Florissant, Cheyenne Canyon, Buena Vista (W. M. Wheeler). NEW MEXICO: Cloudcroft, 9,000 feet, Cox Canyon, 9,300 feet, Sacramento Mts. (W. M. Wheeler). ARIZONA: Coconino Forest (W. M. Wheeler); San Francisco Mts., 13,000 feet (W. M. Mann); Jacobs L., Kaibab Forest (N. A. Weber). MONTANA:

Bear Paw Mt. (Pergande Coll.); Flathead Lake (W. S. Creighton). IDAHO: Moscow (J. M Aldrich). UTAH: Lehi (W. A. Kooker); Bryce Canyon, 8,100 feet (N. A. Weber).

The winged forms appear from July to September (Connecticut. Aug. 24–29; New York: Sept. 26; Ohio: Aug. 1–Sept. 21; Ontario: Aug. 3–Sept. 5; Illinois: July 27–Aug. 15; South Dakota: Aug. 9; North Dakota: July 25–Aug. 8; Saskatchewan: July 15; Montana: Aug. 23; Arizona: July 21–28; New Mexico: July 3–9; Utah: July 26).

This subspecies is comparatively distinct in the possession of a high lamina along the anterior margin of the bend and base of the antennal scape in the worker and of short antennal scapes in the male. Males are occasionally found, however, with these short scapes in colonies containing workers and females much like ***fracticornis*** and there is the usual variation in body structure in all castes in other colonies. The antennal scapes of the worker may be considerably compressed at the bend and the lamina reduced to a slight postero-medial carina; the epinotal spines may be distinctly shorter than the declivity ventral to them and may be straight, without deflected apices.

The variety ***monticola*** has been synonymized after the examination of all the type specimens. I cannot clearly separate them from the ***emeryana*** specimens from Illinois. Comparable ants from many localities in the East and the West are before me and agree well with the ***monticola*** descriptions and specimens.

The subsp. ***latifrons*** Starcke, which was described from four workers from Buffalo, N. Y., has been synonymized after the examination of the original description and of a figure of the antennal scape in "De Levende Natuur" (1927, fig. 49) which was labeled "***M. schencki*** (Buffalo, metatype)", but of which Stärcke wrote "This is my ***latifrons***." The description and the figure agree well with my specimens of ***emeryana*** from New York.

BIOLOGY

Myrmica emeryana usually nests in moist and shady situations. As a rule it inhabits ecological niches intermediate between the sunny, well-drained sites of ***americana*** and the damp to swampy places preferred by ***brevinodis***. The ants are often found in woods forming irregular chambers in the soil, but may nest among grass roots. The entrance is sometimes protected by a collar of plant fibers, a more common feature of ***americana*** nests, however. The ants also make use of fallen branches, boards or stones to conceal the nest entrance and conserve humidity. The ants are timid, "feigning death" when disturbed, and are generally slow-moving.

Myrmica schencki var. **kutteri** Finzi

M. schencki var. *kutteri* Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, ***29:*** 111, ♀.

Switzerland: Zermatt (H. Kutter).

For a description of this form, see the reference above.

Myrmica schencki var. **obscura** Finzi

M. schencki var. *obscura* Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 111–112, ☿ ♀ ♂.

Venezia Guilia: Mt. Nanos, Mt. Castellaro; Hungary: M. Tatra.

For a description of this form see the reference above.

Myrmica schencki var. **plana** Karawajew

M. lobicornis var. *plana* Karawajew, Konowia, 1926, *5:* 283–285, fig. 1, ☿.
M. schencki var. *plana* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 208, 209, ☿.

Worker (after Karawajew):

Head broad, the occipital margin more even than in *M. sulcinodis*. Scape surpassing the occipital margin; at the base almost evenly bent and with an acute, somewhat long, angle on the bend. Dorsal surface of the thorax quite lacking a clear mesoëpinotal impression. Epinotal spines moderately long, thin, somewhat acute apically, situated at about 45 degrees from the basal surface. Petiolar node with a somewhat rounded angle and a concavity on the anterior face, followed by a convexity basally. Postpetiole broadened posteriorly, somewhat broader than long, in profile the upper convexity is not equalled ventrally. Sculpturing coarser than the type (*M. lobicornis*), on the dorsal surfaces of the head and thorax coarse longitudinal rugosities. Pedicel somewhat coarsely wrinkled. Otherwise similar to the type (*M. lobicornis*). Color dark brown-ferruginous.

Type Locality: Taurish Gouv.: New Askania (Spat and Dobrschansky).

"I think the var. *plana* must be placed with *schencki* E. for, although the frons of this variety is not as strongly narrowed as in the type, yet the outer borders of the frontal carinae are more strongly curved outwards."

Myrmica schencki var. **salina** Ruzsky

M. scabrinodis var. *salina* Ruzsky, Formic. Imp. Rossici, 1905: 687, ☿ ♀ ♂.

Worker (after Ruzsky and Emery): Length 4.7–5 mm.

Frontal carinae much broadened in the form of lobes; lobe of scape less oblique than in *scabrinodis*, more than in *lobicornis*; surface between the reticulations on the sides of the head punctate but shining; middle part of the clypeus smooth, shining. Epinotal spines long, straight. Color somewhat dark.

Female (after Ruzsky): Length 5–6 mm.

Similar to the worker but colored somewhat darker. Wings brownish on the basal half.

Male (after Ruzsky and Emery):

Sculpturing of the head weaker than in the typical form, punctate-rugulose. Antennal scape thickened in the middle. Pilosity less dense, wings as in the female. Antennal scape lengthened as in the typical *scabrinodis*.

Type Locality: Gouv. Orenburg: Tobolsk.

Emery saw the type specimens and believed them a transition from the typical *scabrinodis* to *schencki*.

According to Ruzsky this ant lives beside salt lakes in deep holes in

the earth. The nests have one or more openings surrounded by a little mound of soil and small dried-up pieces of grass. In Siberia, at Lake Gorki, he found a nest among dried bushes, the cavities goind deep into the earth. In the salt region of Tsara-Kul he found the nests in cavities in the soil among bushes (*Saussurea amara*).

Myrmica schencki subsp. **spatulata** M. R. Smith

Myrmica schencki spatulata Smith, Ann. Ent. Soc. Amer., 1930, *23:* 566-7, figs. 1-4, ♂ ♀.

Original Description.

Worker: Length 4.3–4.6 mm.

"Head, excluding mandibles, distinctly longer than broad, with rounded posterior border and posterior angles and convex sides. Eyes prominent, oval, convex, placed at a distance from the mandibles greater than their largest diameter. Mandibles well-developed, triangular, with 7 or 8 distinct teeth, the apical 3 the most strongly developed. Clypeus strongly convex; viewed laterally, it is decidedly protuberant. Frontal area triangular, impressed. Antennae 12-segmented; scapes robust, surpassing the posterior border of the head, each with a very large lobe at its base, which when viewed from above is very large and strikingly spatulate in outline; funiculus each with the last 3 distal segments enlarged but scarcely forming a distinct antennal club. Thorax viewed laterally with a distinct pro-mesonotal suture, the mesoëpinotal region strongly impressed dorsally, less so laterally, but not forming a distinct suture. Epinotal spines long and acute, directed backward and upward, the spines about as long as the face of the declivity of the epinotum. Petiole, viewed in lateral profile, with flattened superior surface which meets the anterior surface in an almost distinct right angle; below with a short, blunt, anteriorly projecting spine. Postpetiole viewed from the same profile as the petiole, wider dorso-ventrally than antero-posteriorly. Gaster from above oval, the apex with a distinct sting.

"Mandibles, clypeus, frontal area, declivity of epinotum, appendages and gaster shining; remainder of body subopaque. Mandibles coarsely and longitudinally striated; clypeus similarly sculptured. Head coarsely rugulose-reticulate with finely punctate interspaces. Thorax and petiole coarsely rugulose, the rugulae with a distinct longitudinal trend.

"Pilosity yellow; coarse, suberect to erect, moderately abundant over all parts of the body, more reclinate on the legs. Pubescence of the same color as the pilosity, closely appressed to the body and so sparse as not to obscure the surface.

"Color highly variable in different specimens, in general, yellowish-brown to reddish-brown; appendages lighter, gaster black. The dorsum of the head, thorax, petiole and postpetiole more or less irregularly infuscated and as a rule darker than the rest of the body except the gaster.

Female: Length 5.5–6 mm.

"Very similar to the worker in all respects but proportionally larger. The head bears three not very distinct ocelli, which are arranged in a

nearly equilateral triangle. The sculpturing of the body although similar to that of the worker is much coarser. On the thorax, especially the sides, the rugulae are regular, almost equidistant, and have a longitudinal trend.

"Pilosity and pubescence hardly distinct from that of the worker.

"Color much deeper than that of the worker; dark reddish-brown, with the infuscation on the dorsal surfaces of the body darker, thus giving the ant from above a blackish appearance.

"Described from 6 workers and 4 dealated females, all of which were taken from a nest in the soil in a low heavily-wooded area, subject to occasional inundations, 5 miles west of Starksille, Mississippi. Cotype in the collections of the Department of Entomology of the Mississippi A. & M. College, the collection of Dr. W. M. Wheeler, and my collection."

This subspecies is known only from the type locality and from Rara-Avis in the same state and the males have not yet been described. Transitions between this subspecies and ***americana*** from Rockford, Illinois, and from Colorado are in Dr. Wheeler's collection.

Myrmica schencki var. **starki** Karawajew

M. schencki var. *starki* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 208, ☿; Zool. Ana., 1931, *93:* 29, ☿.

Worker (after Karawajew):

Head coarsely and longitudinally sculptured, laterally and posteriorly coarsely reticulate, with sharply impressed basal sculpture, somewhat shining. Thorax coarsely, irregular, especially on the dorsal surface, longitudinal sculpturing. Petiole, from above, very coarsely and sharply wrinkled in which a longitudinal trend can scarcely be distinguished; the postpetiole longitudinally and finely sculptured.

Dark brown, thorax and pedicel barely reddish, appendages likewise reddish, hardly lighter than the thorax.

Otherwise as in the type.

Type Localities: Chibinic Mt. (Kolskij Peninsula), Border along, also tundra by, the Imandra Sea, 14, 22.VII.1928 (V. Starck). Baikal Sea Region: Tanchoj-Mischicha, Listwenitschnoje (W. Karawajew).

"Apparently nearest the var, *obscura* Finzi."

Myrmica schencki var. **subopaca** Arnoldi

M. schencki vat. *subopaca* Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 172, ☿.

A form from the U. S. S. R. unknown to me.

Myrmica schencki subsp. **tahoensis** Wheeler

Myrmica scabrinodis schencki var. *tahoensis* Wheeler, Proc. Amer. Acad. Arts and Sciences, 1917, *52:* 504, ☿ ♀ ♂.

Original Description:

"Small; antennal scapes geniculately bent at the base and at the flexure with a small rounded lobe, appearing as an acute tooth when the

scape is seen from the side. Frontal area very distinct, triangular. Frontal carinae large, lobular. Epinotal spines slightly shorter than the base of the epinotum, as long as their distance apart at the base, rather slender, distinctly curved downwards at their tips. Petiole in profile blunt and rounded above.

"Head, thorax and pedicel very coarsely and in the main longitudinally rugose, the surface subopaque; frontal area opaque, finely and densely longitudinally rugulose; concavity of epinotum smooth and shining like the gaster.

"Hairs rather long, abundant and suberect on the body and legs as in the typical *schencki* var. *emeryana* Forel.

"Head and gaster black; mandibles, antennae, thorax petiole and post-petiole deep brownish red; legs slightly more yellowish red.

Female (dealated): Length 4.5–5 mm.

"Very similar to the worker; pronotum transversely, mesonotum and scutellum strongly, pleurae more feebly longitudinally rugose; petiole and postpetiole longitudinally rugose above, densely and finely punctate on the sides and below as in the worker. Color like that of the worker, except that the thoracic dorsum and some spots on the pleurae are black.

Male: Length 3.5–4 mm.

"Antennae very short, the scapes especially, which are feebly bent at the base and no more than three times as long as broad and shorter than the three basal funicular joints together; club 4-jointed. Frontal area large, distinct, triangular. (Sagittae of the genitalia with 21–23 serrations; volsellae as illustrated). Sculpture and pilosity much as in the variety *emeryana*. Color dark brown; head black; mandibles, tarsi and articulations of legs brownish yellow; palpi whitish. Wings pale hyaline throughout, not infuscated at the base as in *emeryana*.

"Described from numerous workers, several males and two females from several localities about Lake Tahoe (Tallac, Angora Lake, Glen Alpine Springs, Fallen Leaf Lake) (California, July 24–28, 1915). The colonies are small and nest under stones in shady places."

Dr. Wheeler collected this handsome subspecies again on July 23, 1917, at Alta Meadow south of Lake Tahoe, California. The antennal scape in the males of this collection varied in length to the equivalent of from 3–4 of the following joints together.

Myrmica rugulosa Nylander

M. rugulosa Nylander, Act. Soc. Sc. Fennicae, 1849, *3:* 32, ♀ ♂; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 91–93, fig. 4; Stärcke, De Levende Natuur, 1927, 13, fig. 42.

M. scabrinodis rugulosa Karawajew, Konowia, 1926, *5:* 285; Kuznetzov-Ugamskij, Zool. Anz., 1929, *83:* 45.

Worker (after Nylander, 1856): Length 3.5–4.3 mm.

Similar to the preceding (*M. ruginodis*) but smaller, more opaque, paler, frontal area indistinct.

Female (after Nylander, 1856): Length 5.5–6 mm.

Similarly distinct from the preceding female, frontal area inconspicuous, pedicel less rugose; epinotal spines as long as in the worker.

Fore wings 5 mm. long, from the base to the middle very lightly lutescent.

Male (after Nylander, 1856): Length 4.5–5 mm.

Similar to the male of *M. scabrinodis*, pilosity of the tibiae much shorter, decumbent; mandibles about 5-dentate; scape as long as the first three joints of the funiculus.

Distribution: North and Middle Europe; Daghestan.

Myrmica rugulosa subsp. **caucasica** Arnoldi

M. rugulosa subsp. *caucasica* Arnoldi, Folia Zool. et. Hydrobiol. (Riga), 1934, 6(2): 165, ☿ ♂.

A form from the U. S. S. R. unknown to me.

Myrmica rugulosa subsp. **constricta** Karawajew

M. rugulosa var. *constricta* Karawajew, Travaux Syst. et faun., Ukrainian Acad. Sci., Kiev, 1934, p. 74.

M. rugulosa var. *minuta* Karawajew, Acad Sc. Ukraine, 1929, *13:* 204, ☿ ♂, (nec *M. laevinodis* var. *minuta* Ruzsky, Formic. Imp. Rossici, 1905: 670, ☿).

Worker (after Karawajew): Length 3–3.5 mm.

Frons as in the var. *ruguloso-scabrinodis* Karawajew, sculpturing weaker than in the type, color lighter and more even, the gaster hardly darker than the rest of the body.

Male (after Karawajew): Length 4 mm.

Scape as long as the three following joints together; these latter of a length comparative with those of the var. *ruguloso-scabrinodis*. Length of the fore wings: 4 mm.

Type Localities: Kiev region, on both sides of the Dneiper, pine forest behind Nikolskaja Slobodka, 1.VIII. 1919 (W. Karawajew).

These came from a hilly region; the nest, without a mound, was under coarse grass in sandy ground. About the entrance were arranged bits of reeds and grass stems in oblique positions. Upon digging up the colony and transferring it to an artificial nest he found two queens which were lost in the intervening years.

Similarly in North Dakota I found *M. sabuleti* subsp. *americana* surrounding the nest opening with a collar of grass particles.

Myrmica rugulosa var. **hellenica** Forel

M. scabrinodis rugulosa var. *hellenica* Forel, Rev. Suisse Zool., 1913, *21:* 431, ☿ ♀.

Worker (after Forel): Length 3–5 mm.

Frontal area completely and densely striate as in *sulcinodis* Nyl. but the size and general aspect are those of *rugulosa*, likewise the form of the scape.

Female (after Forel): Length 4–5 mm.

Same differences as in the worker.

Type Localities: Greece: Patras, Corfou.

Myrmica rugulosa subsp. **limanica** Arnoldi

M. rugulosa subsp. *limanica* Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 162, ♀ ♂.

A form from the U. S. S. R. unknown to me.

Myrmica rugulosa limanica var. **chersonensis** Arnoldi

M. rugulosa limanica nat. *chersonensis* Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 164, ♀ ♂.

A form from the U. S. S. R. unknown to me.

Myrmica rugulosa limanica var. **strandi** Arnoldi

M. rugulosa limanica nat. *strandi* Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 164, ♀.

A form from the U. S. S. R. unknown to me.

Myrmica rugulosa var. **slobodensis** Karawajew

M. rugulosa var. *slobodensis* Karawajew, Travaux Inst. Zool. Biol., Kiev, 1936.

A form from the U. S. S. R. unknown to me.

Myrmica rugulosa subsp. **ruginodiformis** Karawajew

M. rugulosa var. *ruginodiformis* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 204–205, ♀ ♂.

Worker (after Karawajew): Length 3.5–4 mm.

Epinotal spines clearly shorter than in the type. The clypeus, in many examples, strongly triangular, the apex, however, being rounded. Head and gaster dark brown.

Female (after Karawajew): Length 5–5.5, mm.

Color as in the worker, except that on two of the examples the middle of the posterior half of the mesonotal scutum and the scutellum are reddish yellow. In the other specimens these areas are prolonged anteriorly and appear as three dark stripes. Fore wings 5.5 mm. long. Otherwise as in the worker.

Male (after Karawajew): Length 4.5–5 mm.

Scape somewhat longer than the 5 following segments together. Epinotum with weak, blunt gibbosities. Petiole conic, with rounded node.

Sculpturing comparatively fine and somewhat irregular, the pedicel dorsally smooth and shining, the sides finely and longitudinally striate. Dark brown, the antennae and legs somewhat lighter, the mandibles yellowish. Fore wings 4.5 mm. long.

Type Locality: Karkara, east of Issyk-kul, upper course of the Kegeni River, 1,950 meters, 16.VIII.1925. (N. Kuznetzov-Ugamskij).

Taken on a mountain steppe among *Festuca*.

The male of this form has so much longer antennal scapes (equal to the 5 following segments instead of 3), that it may belong to another species.

Myrmica rugulosa var. **rugulosa-scabrinodis** Karawajew

M. rugulosa var. *rugulosa-scabrinodis* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 205, 206, fig. 1, ☿ ♂.

Worker (after Karawajew):

Differing from the type in that the frontal carinae are somewhat divergent and at the apices somewhat thicker.

Male (after Karawajew): Length 4.5–5 mm.

Scape as in the type, as long as the 3 following segments together. The 1st segment (of the funiculus), on the outside, is quite as long as the 2nd, which is much thinner, the 3rd is two-thirds as long as the 2nd. Anterior division of the mesonotum between the Mayrian furrow is smooth and shining, lateral divisions finely striate longitudinally, the scutellum coarsely striate longitudinally, the postpetiole almost entirely smooth and shining.

"I think this is the form which Ruzsky (1905) regarded as the typical form from the Caucasus."

Type Localities: Caucasus: Mzymta River, Tshernomorskij Kreis, 10.IX.1910, ☿ ☿ and 1 winged ♂ (Satunin); Georgijevski-Osetinskij Aul, Kuban Region, 28.VII.1903, ☿ ☿ and 2 ♂ (Koznakov and Dieterich); Jailatsch-Chaman-Tshaj, 6,000 feet, Betsho, Tshaba, Svanetien, Shusha, Gouv. Jelisavetpol; Sotshi, Tshernomorskij Kreis; Armenia: Goktsha, Sevan peninsula.